TOMOLOGICAL
SOCIETY OF
TISH COLUMBIA

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

BRITISH COLUMBIA

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AUGUST, 1916

NUMBER NINE
ECONOMIC SERIES

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

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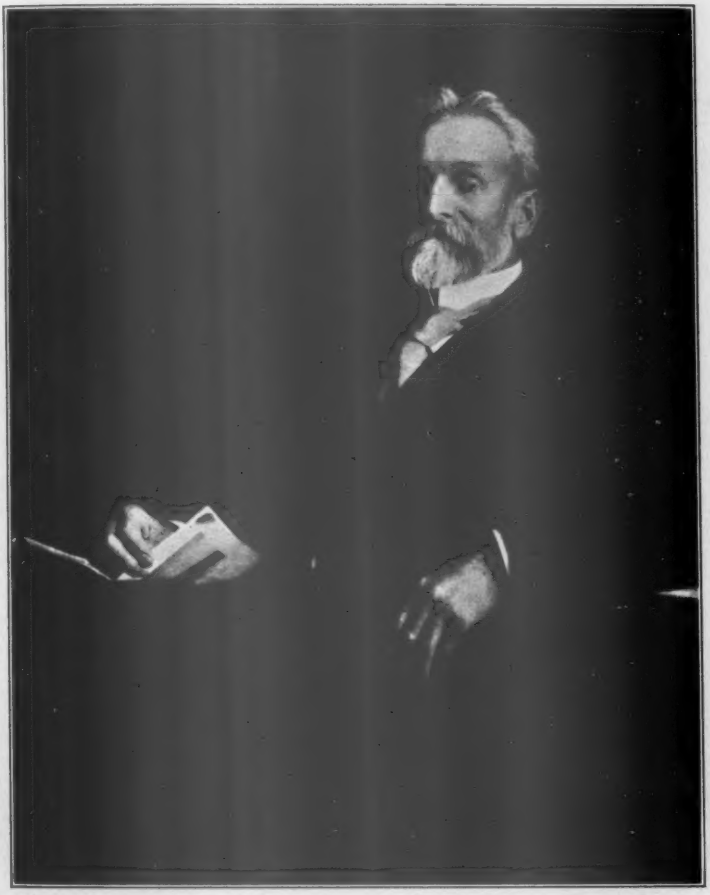

The late Thomas Cunningham, Provincial Inspector of Fruit Pests.
Died February 16th, 1916.

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NOTE.—Numbers 7 and 9 (and, in future, uneven bulletin numbers) of the Proceedings of the British Columbia Entomological Society represent the commencement of the "Economic Series" of bulletins. The numbering of the pages will run in order, and an index will be prepared later, covering the publications of several years.

BRITISH COLUMBIA ENTOMOLOGICAL SOCIETY.

PROCEEDINGS, 1916.

NOTE.—The Fifteenth Annual Meeting of the British Columbia Entomological Society was held in the Provincial Museum, Parliament Buildings, Victoria, B.C., on March 11th, 1916. This Bulletin No. 9 contains the more economic papers of practical or popular interest to fruit-growers and farmers, and in the matter of page numbering is a direct continuation from Bulletin No. 7.

The resolutions and business transactions of the Society, following the Fifteenth Annual Meeting, have been separated from the papers and articles given at the meeting and will appear as a supplementary report.

NOTES ON THE WOOD-TICK (DERMACENTOR VENUSTUS).

By J. Wm. Cockle, Kaslo.

Some years ago I was asked by the late Dr. Fletcher to write an article on wood-ticks, and thinking I knew a lot about their varied idiosyncrasies, I committed my observations to paper. The article never appeared in print, as our dear old friend, Dr. Fletcher, wrote me upon the receipt of the article that he would refrain from publishing it because he considered the average reader would consider that my imagination had probably superinduced a temporary attack of hallucination, and in their opinion I should be immediately elected to the presidency of the Ananias Club.

Since then I have gained in years, and during this time I have had to carry the weight of the reputation of having written for publication a true fish story, so that now, having survived this weighty reputation, I think I can more easily carry the onus of having written some facts about wood-ticks which may be received with scepticism.

In the report of the Dominion Entomologist for 1914, under the heading of "Insects affecting Animals and Man," appears the following: "Our inquiries in regard to the distribution of ticks in British Columbia, and especially of *Dermacentor venustus* on account of its relation to the obscure disease termed tick paralysis in children, has been continued and additional data has been secured." As far as I know, the only data which has been published was that splendid report on tick paralysis in lambs caused by *D. venustus* which was published by our mutual friend, Dr. Seymour Hadwen. This report appealed to me most strongly, as prior to taking up his research-work in regard to this tick I had the pleasure of first meeting Dr. Hadwen and discussing with him the subject of ticks.

The investigation which was started by the Entomological Department regarding ticks originated from a press report which appeared in many Eastern papers, which stated that I was responsible for the statement that ticks produce spinal meningitis, and that there were records of deaths having resulted from this disease in the Kootenays. This statement was entirely wrong, the press reporter having confused spotted fever, spinal meningitis, with the Montana spotted fever. I received a letter by first mail from Dr. Hewitt asking if I had made such a statement. This happily I was able to deny. But the fact remained that there were records of several children who had died from the effects of a tick having attached itself at the base of the skull, causing paralysis and death. Several other cases were recorded where

the child was completely paralysed, but recovered upon the removal of the tick. My object in writing to the papers at this time was to point out that there was danger from wood-ticks when they attached themselves to young children, and this letter and the subsequent agitation which it provoked was the initial point from which the medical faculty in Canada was brought into contact with the results which had come under the observation of several medical men in Western Canada, and led to the receipt of many letters of congratulation and thanks from parents whose children had been affected by wood-tick "bites."

The further reason of my desire to open up the question of ticks has until now remained unpublished.

It is a recorded fact that Montana spotted fever, which produced a mortality in the early times of 90 per cent., was produced by *D. venustus*, and there are also records of this same fever, but in a much milder form, from other of the Western States.

We now come down to the facts regarding *D. venustus* and its ally in British Columbia. I am speaking now as an entomologist, and I wish to make the statement, regardless of all contradiction, that there are two ticks masquerading under the same name. As far as structure and maculation go, they are practically identical, but one is a fever-tick and the other is not.

The ally will walk all over a person without causing any uneasiness except a crawly feeling, whilst *D. venustus* appears to attempt to gain entrance for its sucking-tube in many places, and where any such attack is made it results in a sore spot. I have seen cases where persons were a mass of small irritating sores caused by "bites" from this tick.* This slow ungainly bug crawls deliberately over one in search of a secluded spot at which to attach itself, whilst its nimble ally will travel three times as fast and attempt attachment at many points.

You may ask how I know that they are a different species if their form and maculation are identical. Well, I have watched them, and as an entomologist I know that they have nothing in common; one is a racehorse, the other a hack. This is not a scientific reason; science says that they are one, but the eye of the student fails to observe what science accepts as a fact.

Some years ago after the Department of Washington had made a thorough examination of the wood-tick situation in the Bitter Root Valley, Montana, there appeared in one of the scientific magazines an illustrated article on the subject, and in this the fever-tick was cited as *D. johnsonii*. When and by whom the change in nomenclature was made I do not know, having no reference library, but it seems probable to me that, on account of the similarity in appearance, *johnsonii* has been relegated to that ever-increasing list of synonyms from which it will some day have to be resurrected.

Allow me now to pass on to some personal narratives regarding ticks. The first tick I saw in the Kootenays was in the early spring of 1889. A friend and myself had been out to look for deer, and when we re-entered our rowboat to return home, my friend leaped suddenly out of the rowboat to secure a rock with which he pounded a poor unfortunate tick, which he discovered on the gunwale of the boat, to atoms. When asked why he used such strenuous methods and language, he told me that he had a grudge against all ticks by reason of the misery he had endured from their "bites." The reason for the rock is explained that it is almost impossible to crush a tick. If you place one on a flat board, pressing it down under the thumb with the full weight of the body, it seems only to enliven it, for when the thumb is lifted it will walk off even faster than before. The antipathy to ticks and the fiendish delight which may be evinced by one who has been the subject of their attention may be well indicated by the almost insane vindictiveness of another friend, who marooned a tick on the top of a bare rock in the middle of a sawmill pond. Every morning, hail, rain, or shine, he would row over to this rock to look at the tick and

* NOTE.—The tick Mr. Cockle refers to as "the ally" is undoubtedly *Dermacentor albipictus* (S. H.).

curse it with some of the choicest vernacular to be met with, even in the pioneer West. This tick remained marooned on this rock for over three months. This seems to illustrate that the birds, like man, have an antipathy for ticks.

In the last paragraph I told you of a tick living three months on a bare rock, and now I will record another fact (please remember that these are all facts). Some years ago, when I was operating as a taxidermist, two mountain-goat heads were sent to me to be mounted. After skinning they were immersed in a solution of salt and borax. In this they remained for over a month, and when mounted they were hung up in the sun outside the shed to dry. I had noticed that there were many heavily engorged ticks adhering to the pelt and had removed most of them with a comb, but after the heads had been out in the sun for an hour or two, my attention was attracted to several heavily engorged ticks walking about over the heads. Whether it was the effect of the sun or the taste or smell of the arsenical paste with which the heads were coated which caused them to detach themselves will ever remain a mystery, but the proven fact remains that they will stand submersion, even in a saturate solution of salt, for an extended period.

The susceptibility to the attack from ticks is a mystery. One person or one horse or other animal out of a bunch seems always to be the marked recipient for their attentions. I have known men who would return from a trip through the brush completely covered with ticks—fifty or sixty ticks crawling over the body and clothes is no uncommon occurrence for even a trip of a few hundred yards—whilst their companions, who in many cases were ahead and consequently brushed off the ticks from overgrowing brush, would be practically immune. As an illustration of immunity, I may tell you that I have never had a tick attach itself to me; a very few will crawl over me, but I am not to their liking.

A farmer living in Southern Kootenay had three horses and an old mare. Ticks were very numerous in this community, but the horses seldom had any ticks attach themselves to them, whilst the mare would daily return from pasture smothered with them. The method of freeing her from their attack was somewhat novel. The farmer would drive her around until she was in a heavy sweat, and in this condition most of the ticks would voluntarily detach themselves, while the remaining ones could easily be brushed off.

The methods employed or suggested for getting rid of an attached tick are somewhat novel and varied. Some old prospectors who have had many experiences claim that they can be unscrewed; others try getting rid of them by applying a lighted match to their abdomen; others swear by an application of coal-oil or by means of a wad of chewing-tobacco placed over them. Any or all of these methods may prove effective in some instances, but the fact of the sucking-tube being transparent or nearly so renders it almost invisible to anything but a powerful microscope, so though they may apparently have been removed intact the sucking-tube often remains in the skin. When this occurs it invariably sets up a very bad ulcerous inflammation which does not yield readily to any treatment, often remaining an open sore for months. The most practical remedy is to pull the tick forward with the aid of forceps until the skin is raised, then with a sharp knife cut off the projecting skin containing the sucking-tube; a slice less than a sixteenth of an inch thick is ample to ensure the complete eradication of the sucking-tube.

With all the inconvenience that ticks produce, we may congratulate ourselves on the fact that there has never been recorded a case of Montana spotted fever in British Columbia.

I am conscious of the proverb of the "prophet being not without honour," but have full confidence that this lengthy epitome and the reputation of the writer may safely be left in the hands of the members of our Society for a verdict.

Mr. Parham: This paper by Mr. Cockle is very interesting to me. While he may have written his paper in a joking strain, the relation of ticks to agriculture is no joking matter. The relation of ticks to horses and the annoyance caused are

only too true. We have a great deal of trouble with them, especially in the Southern Okanagan country, and we find them very hard to control. There is absolutely no question that the ticks attack one person and not another, and the same applies to horses. There is no accounting for this dislike or preference; it just occurs. One method of exterminating the tick is to pull it out and cut off a piece of skin surrounding the puncture, but currycombing is a very practical method with horses. Still another common method is employed as described by Mr. Cockle, and that is to work them very hard, so as to cause profuse sweating; but this does not check them. I am very interested in all this and would like to hear further discussion.

Mr. Blackmore: I notice Dr. Hadwen is here and that he will be giving us the next paper, referring to ticks. Possibly he might have some remarks to make now or he might prefer to give us his paper.

Dr. S. Hadwen: I do not know that I can add very much to what Mr. Cockle has said. His observations are without doubt correct, and I can support his contentions on many points. I am afraid, Mr. President, that the paper I proposed to give at this meeting must be cancelled. I had expected to give you a list of the species of ticks that occur in British Columbia. Dr. Hewitt, Dominion Entomologist, however, has just issued a list of Canadian ticks which covers our British Columbia list completely. I received Dr. Hewitt's list yesterday and there is little that can be added to it now.

In regard to this subject, under discussion, of ticks and the evils resulting from their attack on animals, I have dealt fairly fully with the subject on other occasions. Tick paralysis is a disease of animals and is produced in human beings by the bites of ticks. In Cape Colony, South Africa, as well as in this country, ticks have been found to produce paralysis in sheep. Another record comes from Australia. Conditions of paralysis may be caused by several species of ticks, not always by the same one. Paralysis occurs several days after the tick has commenced its attack. During the first three or four days the tick remains quiet, but during the last twenty-four hours or so the engorgement is very rapid. In fatal cases the heart and respiration are affected. If the tick is removed, recovery is very rapid.

While there are about fifteen varieties of ticks in British Columbia, most of those which affect animals produce, not paralysis, but intense irritation to the tissues. It is remarkable that after a bite from almost any of the ticks, itching may continue for years. Severe constitutional disorders may result, and the ulcers which may form are very slow to heal.

In reference to the connection between ticks and animals, I have frequently heard it claimed that ticks prefer certain trees in which to stay. I am inclined to think that this is the case, and is caused by a preference on the part of the animals, after becoming laden with ticks in the pasture or range, to collect under some favourite tree for shade. Some animals are, as pointed out, more susceptible to ticks than others. I have noticed that weak animals are always affected the worst, but whether or not the weak condition is directly the cause of the attack I cannot say. Once an animal has a tick on it, you will find that a rag saturated with coal-oil will cause it to relinquish its hold. Any oil will work, but I acknowledge a certain difficulty in getting rid of ticks, especially on horses.

Mr. Parham: I haven't had very good success with oil.

Dr. Hadwen: You will find it will work, I am sure. A small drop even on the stigmal plate will cause a tick to relinquish its hold. It works every time. You can prove it for yourself in the laboratory.

Mr. Treherne: Is it so that "spotted fever" does not occur in British Columbia?

Dr. Hadwen: We have never heard of any case.

Mr. Parham: What about ticks on poultry?

Dr. Hadwen: I have never heard of poultry being affected by ticks. But if a chicken is affected with lice, it is advisable to dust thoroughly with sulphur. Any dusty substance kills them instantly. We have very few records of ticks taken on birds in this country.

Mr. L. E. Taylor: I found one on a bird on one occasion. Mr. Cockle in his paper mentioned about birds not seeming to like ticks, but I know of a team of oxen in South Africa which, when they got home at night, covered with ticks, the chickens would make their evening meal of the ticks on them. It was really an extraordinary sight to see the birds jumping up at the bellies of the oxen.

In South Africa arsenical dips for sheep are considered good things, despite the poison. I have seen the hair removed completely by dipping too many times. Up to a certain point dipping is fine. Donkeys are especially afflicted with ticks. One cure for ticks in South Africa is to apply a hot coal to the body. This causes the tick to loosen its hold. On other occasions a nearly full-gorged tick, if left on the body, will drop off naturally, with little evil results.

Dr. Hadwen: Deer in this country are often attacked by what are called "ticks," but they are not true ticks. At certain times they fly, and when they light on an animal they throw off their wings and live as body-parasites.

Mr. Wilson: When I was in India I got what was called a "black man's louse" on me, by sleeping too close to the natives.

Dr. Hadwen: That, of course, is due to the pigmentation of the skin from a negro. The species of the louse was the same as the "white man's louse."

Mr. Treherne: Mr. Cockle in submitting his paper attached a letter in which he mentions some interesting details. He mentions taking a very minute tick from a shrew, which is being sent to Washington, D.C., for determination. He has also added to his records of snow-insects by the capture of another species of "snow-flea," whose name he does not mention. The first specimens were taken on the snow when the thermometer registered 25° Fahr., actively walking. This is the lowest temperature that he has ever seen any insect-life active and alive. He has also discovered another small colony of golden snow-fleas in a locality different to any one known up to the present. It is to be hoped that Mr. Cockle will give us further information on this interesting form of insect-life on another occasion.

Mr. Blackmore (Vice-President): I will now ask Mr. Tom Wilson to give us his paper on the "Cottony Maple-scale."

THE COTTONY MAPLE-SCALE (PULVINARIA INNUMERABILIS).

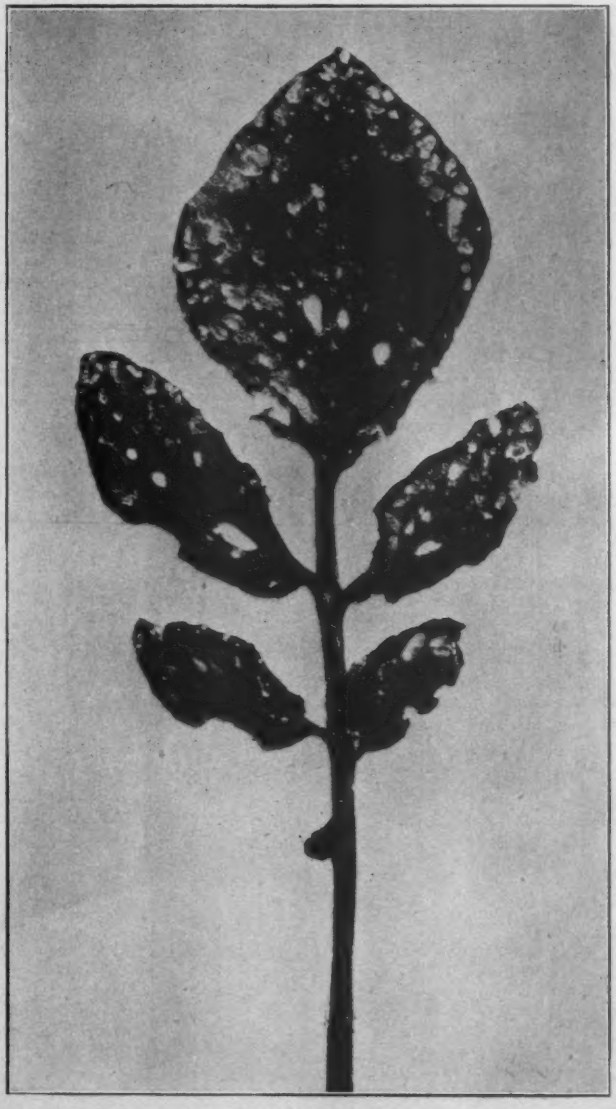
By TOM WILSON, F.R.H.S.

The above-named insect has increased both in numbers and distribution during the past season to an almost alarming extent. It has been noticed in the City of Vancouver on a great variety of food-plants, such as thorns, poplars, grape-vines, willows, and gooseberries. At Agassiz, on maples and other plants. At Lytton, on *Acer glabra* and *Acer negundo*. Near Nanaimo, the willows out in the woods were attacked, as were also the maples, and the writer has had letters from many gooseberry-growers in various parts of the Province, sending in specimens of the affected twigs bearing the characteristic white cottony masses. We have not noticed them so numerous in the Province since 1899, when the thorn hedges and also currant-bushes around Chilliwack were all heavily infested. They almost disappeared the following year.

This insect is usually very inconspicuous in the early part of the year, but comes into notice after the females have attained their full growth in May or June, and have excreted a cotton-like substance, which protrudes from under the scale, covering the insect.

The entire under-surface of limbs is frequently covered by these insects, with their cottony fibres full of minute eggs and young. The species is very prolific, and the late I. S. Putman, who published an exhaustive report on the insect, says that a female will lay from 500 and more frequently 2,000 eggs in the season. When the young leave the mother they establish themselves along the veins and usually on the under side of the leaves, sometimes on the upper side. It has been noticed that the young insects grow more rapidly on the under side than on the upper. The

first moult takes place about a month after the young leave their mother, and is followed by the secretion of a homogeneous layer of wax. The insects are yellowish for a period, the females showing deep-red marking about the time the delicate two-winged males make their appearance. They later change to a brownish colour and migrate to the sides of the twigs before the fall of the leaf.



Work of the potato flea-beetle on potato-leaves. This form of injury is common in the Province. To control, apply Bordeaux mixture, accompanied by arsenate of lead, in the spring. (Photo by R. C. Treherne.)

The best time to eradicate the pest is when the trees are dormant and the leaves have fallen. The winter strength of the lime and sulphur spray, to which has been added a quantity of caustic soda, will thoroughly dissolve the scales, and they may also be kept in check by washing them off with a strong head of water from a hose.

DISCUSSION.

Mr. Taylor: I should not wonder if we have a similar condition in the Okanagan. We had it very bad last year, and it did considerable damage this year. It is very common on all the wild trees, and apparently causes fruit and trees to turn black.

Mr. Wilson: The late Dr. Fletcher said we had one species of our own on the Coast.

Mr. Treherne: That was *P. occidentalis*, but I believe it is now conceded that this form was only a variety of *P. innumerabilis*. The former name is dropped.

Mr. Wilson: Yes; speaking from memory, I believe I am correct in saying that this scale was first recorded for this Province at Chilliwack about 1899. Last season I took it at Anderson Lake, in the Lillooet country, where it did a good deal of damage.

With your permission, Mr. Chairman, I might mention that while in the Lillooet country last year I found the spruce-bud worm and the pine white both present and doing damage. The spruce-bud worm outbreak occurred both at Anderson Lake and between Lillooet and Bellamy Lake. I do not remember ever having seen these two insects working together. The spruce-bud worm has not been common on spruce for many years. Two years ago it was numerous.

Mr. Sherman: With regard to the pine white, it was very numerous this past summer on Savary Island, eighty miles up the Coast.

Mr. Blackmore: In past years it has been very common in the vicinity of Goldstream, but my total captures during the past five years in this locality has been about five specimens.

Mr. Downes: At Armstrong I have taken the pine white on two occasions; the first, a male, ten years ago; and last year a female.

Mr. E. M. Anderson: Around Sooke, where it used to be very common some years ago, to-day you don't see one. Last summer, as a result of several collectors among the teachers taking the elementary training course, I received four records of the pine white right in this city (Victoria). These were taken in the vicinity of Clover Point and the cemetery.

Mr. Treherne: I took numerous specimens at Agassiz during the past year. I had not noticed it during the three years preceding.

THE PEA-WEEVIL IN BRITISH COLUMBIA.

BY R. C. TREHERNE, FIELD OFFICER, ENTOMOLOGICAL BRANCH, DOMINION DEPARTMENT OF AGRICULTURE.

In April, 1915, Mr. H. S. Brodie, Assistant to the Entomological Branch Laboratory, Agassiz, B.C., drew my attention to some peas he had collected from a consignment of seed-peas purchased by a local farmer of Agassiz (Mr. Sweatman) from a Vancouver seed merchant. These peas were infested by the pea-weevil (*Bruchus pisorum* L.). There were no live adults in the peas Mr. Brodie collected, and later examination of Mr. Sweatman's seeds did not show any live beetles; however, the fact remains that great care must be exercised by seedsmen, farmers, and quarantine officials, especially with regard to small consignments which may evade inspection or fumigation, for fear of introducing this pest.

On inquiry from the seed merchant in Vancouver I found that a considerable amount of peas had been sold recently, and that for the most part the peas had been imported from Ontario.

At the present moment there are no pea-weevils recorded for British Columbia, a fact which is indeed fortunate, because this small beetle has frequently made the growing of peas an impossibility in certain parts of Ontario. There is no doubt that this beetle will thrive in British Columbia if it is introduced, and it can only be introduced through such a medium as mentioned above; that is, the importation of seed from an infested area.

Inquiry in Ontario has elicited the information that peas are not subject by law to fumigation before sale or distribution, but seedsmen, to protect their own business, usually fumigate on their own responsibility. Further, I am informed, the numbers of the pea-weevil in Ontario are gradually increasing in those districts where peas are being grown. Hence, those Provinces, and in particular British Columbia, where the pest does not occur at present, must guard against the introduction of this beetle, which is unquestionably one of the most serious to the pea-growing industry of Ontario.

The adult weevil is about ⅛ inch long. In general its colour is black, with irregular markings of black and white, over which may be seen a slight brown pubescence. Farmers in British Columbia will recognize it from these characters and from the fact that it may be found as a beetle inside the peas. Its presence is indicated by circular round holes in the pea; consequently when these signs are seen there should be an immediate report made to the Government.

ENTOMOLOGY IN THE PUBLIC SCHOOL.

BY J. A. HAMILTON, PRINCIPAL, JOHN NORQUAY PUBLIC SCHOOL, SOUTH VANCOUVER.

By way of introducing the topic upon which I desire to devote a few minutes of your precious time, and which I shall treat from a standpoint, theoretical as well as practical, permit me to quote William W. Campbell on the subject of agriculture in general. He states: "The nation of the future which will rule the world will be that one which lays most stress on her rural population and her rural wealth. She will be the one in which the great mass of her people till the land. My hope for my Canada is that she will turn all her energies in the direction of the soil, and that she will become a country of orchards and vineyards and wheat-fields and meadows, and a great pasture for the herds of the earth."

Also, the Royal Commission on Technical Education and Industrial Training has this to say: "In all progressive countries education is being adjusted to meet the needs of the children . . . to interest them in rural life, and to qualify them to follow it with advantage."

And let me add a note from the Report of the Royal Commission on Agriculture: "We would suggest the teaching of the fundamental principles of agriculture, with the art of giving . . . some knowledge of botany, soils, and kindred subjects."

The above excerpts will tend to make manifest the standing of authorities who have the real welfare of their country at heart upon the position and status of the subject of agriculture in the school curriculum; and perhaps no part of it has a more important bearing upon its success or failure, its improvement or its retardation, than the study of entomology in its various phases of interest.

A metropolis to be ideal must, besides constant consideration of the æsthetic and the means and methods of attaining a maximum in that respect, note very carefully that all its putrefaction and festering sewerage is deposited at no little distance from its vicinity; all that would mar or destroy must be slowly, carefully, and permanently, if at all possible, removed; so, also, the most profound and intricate study must be made of all the causes responsible for the attainment of the highest and noblest results in agriculture. Perhaps in no other branch is there such a field for research along these lines than in the subject of entomology; besides affording us means to accomplish with satisfaction some of the finest results in nature's processes in agriculture, it gives us a means of removing or at least checking to a degree much which tends to make agriculture a burden and a care, which many engaged in its pursuit would rather shirk than carry.

Our boys and girls of to-day will be our farmers and farmers' wives of to-morrow. Where, then, is there a more fruitful area to sow this knowledge than in our schools, colleges, and universities? And judge for yourself which of the three is the most desirable institution in which to impart it: the school, where the interest is obtained for the first time in the wonderful vistas of new worlds opened to view, where the mind is most receptive to influences of whatever nature they be; or the college, where in cases innumerable the youth has other multitudinous interests among which to divide his time and substance; or at the university, where the curriculum is so diversified that something must be eliminated to make room for the course of the particular bias or trend which the student may have developed through force of circumstances or otherwise.

This subject, then, should be commenced in school just as soon as a child obtains an interest in any object which seems to command his attention, a graded course being essential according to the ability of the pupils. Thanks to the Department of Education, with the substantial aid which it has received from the Dominion Government, many teachers have qualified in this subject. But since the success of its teaching and the resultant enthusiasm of the class proportionately depends upon the dynamic or inert interest of the teacher in the subject, many schools, ideally situated for attaining the acme of perfection in this regard, have not reached the standard they might. Entomology is of such tremendous import that, in my mind—and in this statement, of course, I mean in its relation to agriculture, not apart from it—every teacher should have to qualify in it before he takes up the all-important profession of teaching. To realize how many active teachers are like-minded in this respect, one need only call to mind the large number of men and women in attendance at our recent summer schools. I might state in this connection that the course already referred to and fitting teachers to engage in imparting instruction in entomology might more satisfactorily be carried on in connection with the Department of Agriculture in the University, where men trained in pedagogy, and with this sole aim and interest at heart, the teaching of agriculture in its various aspects, including the instruction, practical, theoretical, and biological, in entomology, could and would no doubt devote their time along these lines. The summer vacation could be utilized as before for this purpose, the teachers receiving remuneration as a matter of course. Should other qualified Dominion experts be required, it seems but fair that they too should receive some extra recognition of their service.

So much for the teacher and his qualifications. What about the mind and attitude of the child?

One of the most powerful instincts inborn in every child that may be used in the school-room is innate curiosity. He wants to know the origin, the working, and the use of everything his eyes alight upon; this period can be religiously used to direct the child along the lines of learning just what bearing these things have upon his own life. Amid these introductions to the new objects of his world, he wonders much about the phenomena of nature. He is again most curious and feels he must know what and why these things are, and advantage of this desire must be taken immediately in the study of that which bears upon entomology; his standard of judgment should again be its attitude upon his own life, whether it is beneficial or pernicious, noting as a consequence the advisability of its preservation or its extinction. The wise teacher will allow him to investigate freely in nature's domains whatever he is interested in, and will be very ready to prompt and lead into further research along these channels.

Entomology is especially suitable for stimulating and training the power of observation and manipulation, the ability to really see and carefully handle. The child doubtless, to begin with, will prove himself a thorough savage in the wanton destruction of insect-life in order to satisfy his thirst for knowledge. But here the opportunity of presenting the ethics of the subject would be seized and presented to his little mind—to live and let live the beautiful or ever-common creatures which are beneficial to him and to those who provide for him, and to destroy that which

is a pest. Also, the principle of cause and effect are easily grasped here. He sees that things are not left to chance, but that this universal rule governs all actions. Later in his school-life he can apply this same rule in history, politics, and personal conduct. Stress generally can be put upon the value of any life in nature, his attention riveted upon the heinousness of destroying any creature without a fair trial, and the British sense of justice and fair play introduced to him for the first time; he will develop a love of the beautiful, the toleration of the useful, even though it is ugly; the general principle that everything has some particular function after all; in fact, this study opens up the widest fields to the student of nature in the wonderful insects of the world, their beautiful fitness for their existence and peculiar characteristics, and he feels a greater reverence for that Great Influence which introduced them all. In fact, a foundation is laid for the moral standing of his after-life.

This subject lends itself well in correlation with the other subjects in the class-room. It is the life of nature-study, which otherwise might be and too often is dry and prosy. In literature, in reading and discussing the lesson, new words are added to the vocabulary; in spelling and dictation likewise; in geography, in the examination of the particular physical and prevalent conditions obtaining in the habitat of special insects, a depth of information is sounded; and perhaps it is most advantageous in the realm of art-work. Here the pupil is introduced to the real and living creature; he sets to work to study its general characteristics; he portrays its likeness to the best of his ability, and he has the satisfaction of knowing that whatever he produces is his own conception of the object, not his portrayal of some other's design or conception. It is his own work, his personal reproduction; he has the wonderful knowledge that he himself without any aid has produced something non-existent before. He is the originator and he revels in the fact. Given such an impetus, much may be expected from such a source, and disappointment is seldom attending.

Let me state that the teaching of this subject is meeting with a largess of success. Its practicability appeals to the live teacher; he gains a greater control over his class than ever before through his association with their victories and their disappointment and defeats. A general enthusiasm, determination, and perseverance is instilled into pupil and teacher alike, which result in the improvement of the other subjects of the curriculum. It affords a rest, a change from the constant routine of the other work; even outings which the youngsters relish to look forward to with keen interest are quite in line with the idea of teaching this subject; as a matter of fact, are perhaps the entire stimulus of the work.

It is not at all within the bounds of this short paper on a wonderfully extensive topic to outline a course in the subject. That has already been attempted and successfully completed by abler hands than mine; suffice it to say that noble work is being done along these lines in our schools of the Province, a work which in time will be crowned with the success it so meritoriously deserves.

In closing, let me thank you for the opportunity of presenting my ideas on the subject to you, an audience of practical men, thoroughly conversant with the topic in hand; in fact, living exponents of its possibilities. We in the schools admire your work, and fully grasp the significance of it, in the world of nature-study. We feel grateful for instruction imparted by various members of the Society during the recent summer schools, deeply appreciating many minor details which have been of untold value in the presentation of the subject to the class, practical hints by experienced men. Had it not been for such advice, our work of a necessity would have been a veritable drudge instead of the pleasure it became for us, and through us was made for others.

Mr. Chairman, I thank you.

THE FOREST-INSECT PROBLEM IN STANLEY PARK.

BY R. N. CHRYSTAL, FIELD OFFICER FOR FOREST INSECTS.*

For a number of years now the unhealthy condition of the coniferous trees in Stanley Park has been a matter for grave concern among the citizens of Vancouver and others interested in the preservation of this area of natural forest which adds so much to the charm of the Western city. The first investigation into the existing conditions was made during the summer of 1913 by Mr. J. M. Swaine, Assistant Entomologist for Forest Insects, Entomological Branch, Ottawa. Following Mr. Swaine's report a field laboratory was established in the park during the summer of 1914, the work being continued throughout the season of 1915. As a result of these investigations a considerable amount of information has been collected relative to the life-histories and habits of the injurious insect species which are responsible for the damage; while at the same time measures for efficient control of the pests and regeneration of the damaged areas have been proposed and partly carried into effect. This matter being one of interest to the members of the British Columbia Entomological Society, the following short account of the results thus far obtained is given below:—

GENERAL CONDITIONS.

Stanley Park was primarily a mixed coniferous forest composed of Sitka spruce (*Picea sitchensis*), Douglas fir (*Pseudotsuga mucronata*), western hemlock (*Tsuga heterophylla*), and western cedar (*Thuja plicata*); the area has been logged over, however, and the majority of the finest trees removed; the present stock being mainly second growth, intermixed with a considerable proportion of broad-leaved species, including maples, poplar, and willow; these in certain places taking sole possession of the ground.

The principal species will be considered in turn in relation to the insect pests associated with them.

THE SITKA SPRUCE (*Picea sitchensis*).

The Sitka Spruce Gall-louse (*Chermes cooleyi* Gillette).—This insect causes elongate cone-shaped galls to form on the young twigs of the spruce in the spring, the twig being killed as a result, and the health of the tree seriously affected when the attack is heavy. The study of the life-history and habits of this insect in Stanley Park resulted in its being identified as *Chermes cooleyi* Gillette, a species studied and described by Professor C. P. Gillette, Fort Collins, Colorado, in his paper entitled "Chermes of Colorado Conifers," Proc. Acad. Nat. Sci., Philadelphia, 1907. The life-history is interesting owing to the fact that the species has two hosts, spending part of its life on the Sitka spruce and migrating thence to the Douglas fir. A short paper on the results obtained in the park will shortly appear in the Transactions of the Entomological Society of Ontario, and in consequence no details will be given here.

The main conclusions drawn from the observed facts of the life-history of this insect are as follows: That this species has proved itself a serious enemy to the Sitka spruce in Stanley Park, causing the death of many trees, both large and small, a survey of the park showing a percentage of over seventy-five affected trees; and that the Douglas fir, the secondary host-tree, is not seriously affected by the presence of the insect. No gall is formed upon the fir.

The Sitka Spruce Aphis (*Aphis abietina*).—Two years ago this insect was reported by Mr. R. C. Treherne as causing serious damage to the spruce in the spring and early summer. When activity starts in spring the apterous viviparous females are to be found in great numbers on the old needles; the following generation develops wings in due course and leaves the spruce about the end of May and the beginning of June; the secondary host-plant is so far unknown.

*Contribution from the Entomological Branch, Department of Agriculture, Ottawa.

Although the work of this insect is very marked upon a limited number of trees in Stanley Park, the present theory is that at the moment it is important only as a very efficient secondary enemy to assist its more destructive ally, the gall-chermes. To form an idea of its potentiality for destruction, however, one need only go and visit the Beacon Hill Park at Victoria, where several large spruce have been seriously damaged by its ravages during the past two or three years. The work of the aphis is very characteristic, causing yellowing of the needles, which finally fall off, leaving

Work of western hemlock chermes, Stanley Park, Vancouver, B.C.
(After Swaine.)

the present year's crop in sole possession. This species has been studied in England by Professor F. V. Theobald (Annals of Applied Biology, Vol. I., No. 1, 1914, May, page 22), who found it destructive to various species of spruce. In 1915 it was also recorded by Professor H. F. Wilson from Corvallis, Oregon, who wrote in June, 1915, that this aphis had proved very destructive all down the coast of Washington and Oregon.

The Sitka Spruce Bark-beetle (*Dendroctonus obesus* Mannh).—In 1913, about the margin of Beaver Lake, three large spruce-trees were found to be attacked by this beetle; the spruce in this region had already been seriously weakened by flooding, consequent on the raising of the level of the lake, as well as by the attacks of *Chermes cooleyi*. Favourable conditions for the extensive spread of this destructive species thus obtained. By the early summer of 1915 the number of affected trees in the vicinity of the lake had increased to thirteen; and in consequence of this fact a survey of the whole park was made to endeavour to locate any other centres of infection. Two other groups were located in widely separated parts of the park, one of nine trees and another of five. All the infested trees were marked for removal in the spring of 1915, which was largely done, the stumps being completely barked to prevent their subsequent use as breeding-places. A further search made during the summer of 1915 only resulted in the finding of a few trees, some of which had been omitted in 1914 owing to their being in use as telephone-poles; these have been marked for removal this spring.

THE WESTERN HEMLOCK (*Tsuga heterophylla*).

Over a large area of the park the western hemlock constitutes the principal species; this tree has been badly attacked and in places entirely killed out by a defoliating Geometrid caterpillar of the genus *Therina*. The moths were in great abundance during the fall of 1913, but in 1914 evidences went to show that parasites and predators had obtained control over the pest, hardly any moths being seen during the summer of 1915. By this time the damage done was irreparable over a considerable area, and in other places the trees were fighting an uphill battle, with sadly thinned foliage, against the effects of the previous year's attack.

The western hemlock bark-beetle is also established in the affected trees and is known to be a destructive species.

Dipterous Maggot in Bark of Hemlock.—The presence of a dipterous maggot of the genus *Cheilosia*, probably the species *C. alaskensis* Coq., family Syrphidæ, was found fairly commonly in the bark of the western hemlock in the park. This insect causes the injury known to the lumberman as "black check," and its presence may be detected by the pitch-tubes of resin which collect at the point of attack. Mr. H. E. Burke, of the United States Bureau of Entomology, in a paper on "Black Check in Western Hemlock," Circular No. 61, United States Department of Agriculture, Bureau of Entomology, 1905, states that the injury is due primarily to the work of the bark-beetle of the western hemlock (*Hylesinus sp.*), which excavates food-tunnels in these places, giving the young maggots a starting-ground for their work. This insect has not yet been exhaustively studied in Stanley Park.

The Western Hemlock Chermes.—In the spring, on isolated trees in the park, the close observer will notice that the foliage has the appearance of being covered with minute flecks of a white woolly material; this marks the presence of the above species. During the first days of spring, the stem mother, an oval-shaped flat louse, 0.5 mm. in length, and dark brown in colour, with the dorsal surface covered with a white woolly secretion, may be found located at the base of the needles, her setæ deeply sunk in the tissues.

Oviposition commences about this time, the young hatching in six or seven days. The complete life-cycle of this species has not yet been established. Although up to the present this species has not proved generally destructive, at least two large hemlock-trees have been killed as a result of its attacks, while others are in a serious condition; the old needles are affected and fall off during the early summer, leaving the tree partially defoliated. The larvæ and pupæ of Syrphus flies and Coccinellid beetles have been found in considerable numbers preying on the young in the spring, and it is possible that these may prove to be an efficient natural means of control.

THE DOUGLAS FIR (*Pseudotsuga mucronata*).

The Douglas fir has on the whole remained healthy; it is considered the healthiest species of conifer in the Province.

THE WESTERN CEDAR (*Thuja plicata*).

The majority of the large cedars in the park are dead-topped, which injury is said to be due to a fungus-disease. So far no discovery of extensive insect-damage to this species has been recorded in the park. The twigs of the cedar are attacked by a leaf-miner belonging to the genus *Argyresthia;* the damage done is not extensive, however.

DAMAGE TO OTHER SPECIES IN THE PARK.

The shrub *Gaultheria shallon* (salal), which is abundant in the park, is rendered unsightly in places by the work of a lepidopterous leaf-miner (*Phyllorycter (Lithocolletis) gaultheriella* Wlsm.). The life-history of this species has been partially studied.

Elders (*Sambucus*) growing in the park were found to have been attacked, and in a few cases killed, by a Cerambycid larva belonging to the genus *Leptura*.

CONTROL MEASURES AND IMPROVEMENTS.

It was shown by experiments carried out by Mr. R. C. Treherne in 1914 that the attacks of the spruce gall-chermes could be readily controlled along the driveways and places where the spruce was accessible. By means of a modern power-sprayer equipped with abundant hose, a solid-stream nozzle, and extension ladder the foliage could have been sprayed up to 140 feet in height. Lead arsenate could have been used to control the caterpillars on the hemlock, and a contact spray, such as kerosene emulsion, fish-oil soap, or nicotine extracts, employed in the case of the chermes. Unfortunately the survey of 1914 showed that the condition of the spruce along the driveways would not warrant the expenditure which would be entailed in the purchase of a power-sprayer, and the crisis of the attack on the hemlock having come and gone, the idea of employing spraying as a method of control was for the time abandoned. At the present time attention is being given to the subject of treatment from a sylvicultural standpoint; the measures proposed entailing clearing up and cutting out of the dead and sickly trees, and the employment of an artificial system of regeneration such as would be easily carried out in a confined area like Stanley Park. The Douglas fir has been recommended as a suitable tree to plant on the areas which are to be regenerated, and it is to be sincerely hoped that in the near future adequate measures will be taken to restore the beauty of the park, and render it a worthy object of care to the city, of which it is an inseparable part.

SOME ORCHARD INSECTS OF ECONOMIC IMPORTANCE IN BRITISH COLUMBIA.

BY R. C. TREHERNE, FIELD OFFICER, ENTOMOLOGICAL BRANCH, DOMINION DEPARTMENT OF AGRICULTURE, AGASSIZ, B.C.

We are approaching very rapidly a condition in the Province of British Columbia, in regard to insects of importance to the agriculturist and fruit-grower, which will very soon demand most serious consideration. We are reaching a point in which the whole system of orchard-management in relation to spraying will have to be reconstructed and viewed from a different light than heretofore. The importance of such pests as the codling-moth, San Jose scale, pear-thrips, woolly aphis, and black currant bud-mite cannot be too lightly dealt with. The fruit-growers of British Columbia, as will become evident in the pages that follow, have since the inception of the fruit-growing industry relied on two main considerations: (1) The youth of their industry and the production of fruit free of serious pests which beset fruit-growers in other sections of Canada; and (2) the wise considerations of the Provincial Government and the Provincial Board of Horticulture, who have dealt with insect pests in most drastic manners, both through an efficient system of quarantine and inspection at the ports of entry, and through careful and pains-

taking effort in the control of incipient outbreaks of such pests which experience have shown to be injurious in other countries. To those of us who realize the gradual ascendancy that many of these insects are gaining in the Province, and who recognize the possible danger that awaits the orchardist in the course of a few years, it is a matter of great concern to know how to influence and advise the grower before it is too late. There can be no question that, unless the orchardist keeps fully advised on the development of the more serious insect pests, there will come a time when many dollars will be lost from lack of preparedness. I do not believe that we will be able to keep these insects out of the Province for an indefinite length of time. That is impossible; but by being equipped with the most approved spray-machines and chemicals each individual grower will be in a position to check, very materially, the progress of a pest and retain it within reasonable bounds before it becomes deeply entrenched.

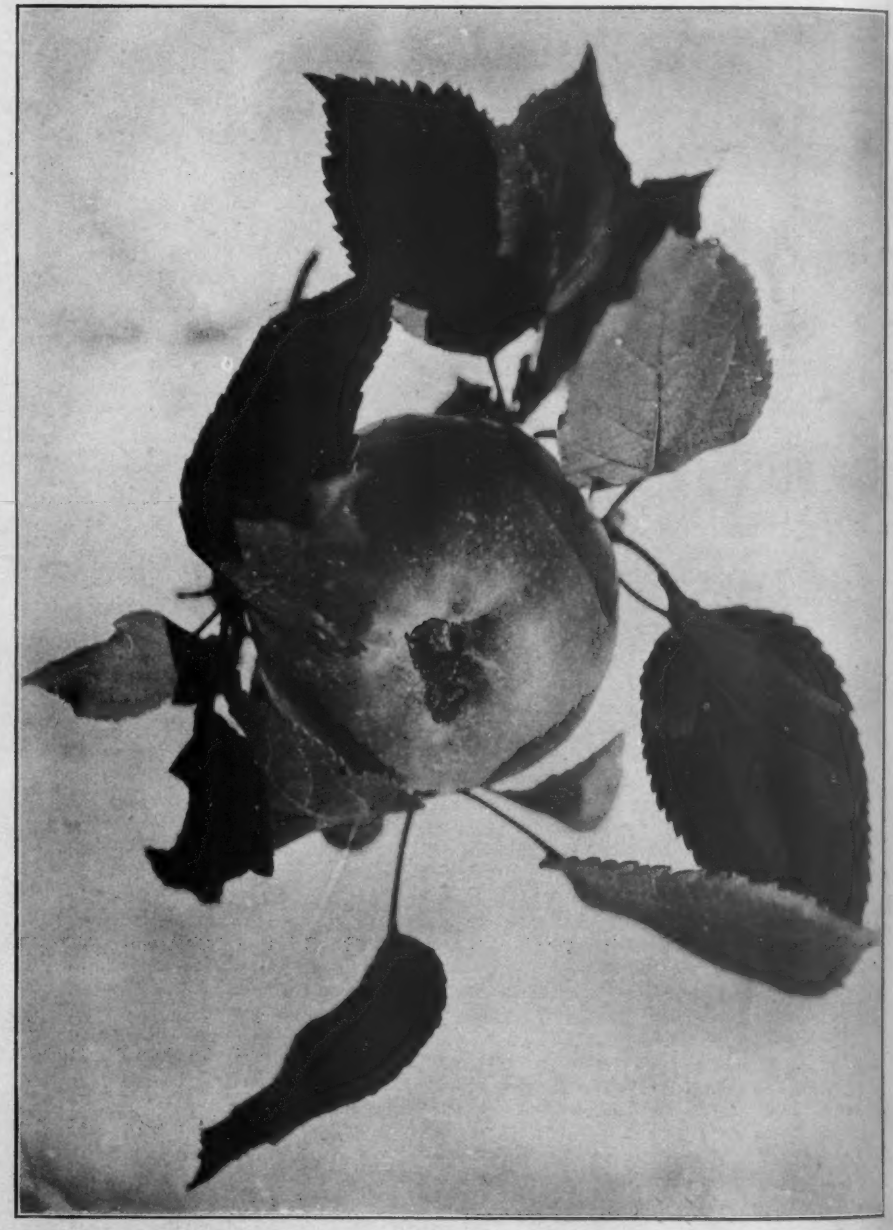
In the year 1892 the insects we find most usually recorded as injurious in the Province are the following: Aphides, cutworms, wireworms, horse-flies, bot-flies, black-flies, mosquitoes, Tipulid larvæ, and locusts, or "grasshoppers."* All of these are such as one would expect to be present in a country just developing its agricultural resources. With the rapid economic development of the Province from this time on, new agricultural problems and new pests came into prominence. The most important of these will be dealt with in the following pages. It is hoped that in detailing these insects the point will be realized that it is important that the fruit-grower shall recognize his position and act accordingly. It is impossible for us, as entomologists, to do more than offer our best services and advice. The development of the Province has gone beyond the state when radical control measures can be reasonably enforced. Hence the obligation most assuredly devolves upon the orchardist in this Province, as in other Provinces, to hold his own on his own estate.

THE CODLING-MOTH (*Cydia (Carpocapsa) pomonella* Linn.).

Historical.—The codling-moth, as all fruit-growers fully realize, is one of the most serious of all insects affecting the fruit of the apple in North America. It has been a matter of surprise that this moth has not established itself as a general orchard pest in the Province before now, when it is considered that it has been for many years a serious insect in the States of Washington and Oregon, and when we know the importation of apples into the Province from infested localities has been continuing for so long. The credit for such immunity as we do possess is due to the efficient system of fruit inspection that is in vogue within the Province and to the prompt eradication methods that have been put into practice immediately an outbreak is recorded.

The first record of the codling-moth having been reared from apples grown in the Province is reported by Dr. J. Fletcher in his report as Dominion Entomologist for 1905. In this instance he received "an undoubted specimen of the codling-moth" from Mr. J. W. Cockle, Kaslo, B.C., and he remarks that until this record came to hand he "had never been able to learn of the occurrence of this insect in British Columbia." In 1905, again, the Rev. J. H. Keen took a specimen of the adult codling-moth in his house at Metlakatla, B.C. This specimen is now in the national collection of the Entomological Branch, Ottawa, but it was undoubtedly bred from imported fruit and not from home-grown apples. In 1906 Mr. Cockle again bred this moth within the limits of the town of Kaslo, and reported the same both to Dr. Fletcher and to the Provincial Department of Agriculture. It is interesting, in passing, to note that a parasite (*Pimpla sp.*) was bred from this material in 1906. In the same year Mr. Stuart Wood, of Kamloops, B.C., forwarded specimens of a "worm" which had been attacking the apple-crop of the city for two or three years to Dr. Fletcher at Ottawa. Dr. Fletcher in his report for 1907 acknowledged the insects above mentioned, and on examination found them to be undoubted specimens

* Second Report of the Department of Agriculture of British Columbia, 1892.



Damage caused to apple by the lesser apple-worm. The injury resembles the work of the codling-moth larva, but it will be noticed that the lesser apple-worm larva feeds more on the surface of the fruit around the calyx. The codling-moth larva, if entrance is made through the calyx, usually passes direct to the core of the fruit. (Photo by R. C. Treherne.)

of the codling-moth. So far as I have been able to gather from local hearsay, the introduction of this moth into Kamloops, which originally occurred about 1904, was brought about by an importation of a consignment of boxes of Ontario apples at Christmas-time. These apples were admitted and stored before an inspection was given the boxes. This outbreak at Kamloops persisted until about 1914, a period of nine years, during which time the Provincial Fruit Inspectors waged a campaign of extermination. As recorded in the Proceedings of the British Columbia Entomological Society, 1914, page 69, approximately 3,000 trees were regularly sprayed and inspected, with a result that to-day, January, 1916, it may be stated that the moth is of no importance and possibly does not exist.

Again, about 1904 another outbreak of the moth occurred near Victoria, B.C. It is supposed that the insect on this occasion gained access to the orchards through the medium of infested pears from California. This outbreak has persisted until the present time (1915). In 1909* an area containing 17,582 trees was involved, and in the summer of that year as many as 7,610 larvæ were taken from individual fruits within that area. During the past summer the infestation still occurred in a few orchards, but the number of larvæ taken barely reached three hundred (291).

Between the years of 1904 and 1911 no further outbreaks occurred, and the Provincial Department of Fruit Pests was engaged in controlling the infested areas around Kaslo, Kamloops, and Victoria.

It is interesting to remember at this point that the fruit-growing industry has practically developed since 1900. The number of trees coming into bearing has increased very remarkably since 1910, and the output of fruit has assumed considerable proportions during the past few years. The first power spray-machine was operated in the Province during the summer of 1910. These facts indicate the youth of the fruit-growing industry, and partly explain the reason why the codling-moth has not obtained a hold in the country. Provided bearing orchards are comparatively few, somewhat scattered, and located a few miles away from railway or shipping centres, and provided an efficient system of orchard inspection is maintained, the chances for the introduction of the codling-moth are reduced to a minimum. Such has been the experience in the Province up to the present, but it is only fair to realize the fact that, even supposing the quantity of codling-moth material imported to-day through the medium of infected cars and fruit is the same as in years gone by, the chances of present and permanent infestation are increased a hundredfold. The number of bearing orchards have increased to a great extent; they are nearer shipping centres, where a moth may transform and fly a short distance to find conditions to its liking; and the area in orchard land to-day is too large for a complete survey by field inspectors. Hence we must realize the situation that, as regards the codling-moth in the Province, we will soon have to accept it as a general orchard pest, controllable only by individual effort.

Let us notice what has occurred in recent years. In the autumn of 1911 a family from Ontario, settling at Rutland, B.C., a locality near Kelowna, brought some cocoons in the cases containing their personal effects. Some old cocoons were found in cracks of some boxes in their possession, and on inquiry it was found that these boxes had been stored in a fruit-cellar on an Ontario farm. During September, 1912, infestation from the codling-moth was discovered in adjoining orchards and evidence clearly pointed to this Ontario family as the immediate cause of the introduction.† The exact area of infestation proved to be one mile in extent. By a system of inspection and spraying, ably described by Mr. W. H. Lyne in the Proceedings of the British Columbia Entomological Society, No. 7, 1915, page 12, the moth was exterminated, and for the past two years no further sign of it has been found.

* Proceedings of the British Columbia Entomological Society, No. 4, 1914, page 69; No. 7, 1915, page 33.

† Proceedings of the British Columbia Entomological Society, No. 2, 1912, page 70; No. 7, 1915, page 12.

In the spring of 1912, again, Mr. W. H. Brittain, at the time Provincial Entomologist, discovered a larva in an apple at Armstrong, B.C. On reporting this discovery the Provincial Department of Fruit Pests immediately took steps to "round up" the infestation. According to Mr. Lyne, in the reference just quoted, twenty trees in three orchards of 800 trees were found infested. It is not quite clear how this infestation was started, but it is believed that the cocoons were introduced on some packing-cases containing nursery stock from Oregon, U.S.A. Close attention was paid to controlling this outbreak, and the methods employed are described by Mr. Cunningham in the Proceedings of the British Columbia Entomological Society, No. 2, 1912, page 68. Evidently success attended the efforts of the Provincial authorities, because no "worms" were found at Armstrong the following season of 1913, and none have been found since (1915).

In 1913, however, another outbreak occurred in the City of Kelowna, introduced through the medium of infected cars. In the spring of 1915 this infestation still required attention, but the number of larvæ taken was very few (eight).

During this past summer, 1915, we unfortunately have to report two of the most serious outbreaks that have as yet appeared in the Province, one at Westbank and the other at Okanagan Landing. The first was reported in August and the latter did not become apparent until late September, when many larvæ were entering hibernation. It is not possible at this time to give any further information on these two outbreaks, as they occurred during the past season, but enough has been shown to indicate that the status of the codling-moth in British Columbia is assuming alarming proportions. In the Annual Report of the Ontario Entomological Society, 1912, I drew attention to the fact that in 1912 the moth was frequenting orchards in Washington State about thirty miles south of the British Columbia boundary-line. I have not received any later information that it had approached closer than thirty miles, but we cannot avoid the fact that with the information given in this article we must regard the codling-moth as an orchard pest that we will soon be called upon to fight.

A third occurrence of some larvæ in the fruit of apples growing at Eburne, B.C., near Vancouver, was discovered in September of the past summer (1915), but at present there is no more information offering on this outbreak. It is believed, also, that another centre of infestation occurred at Kelowna during the past year.

You will, no doubt, be pleased to hear that Dr. C. Gordon Hewitt, Dominion Entomologist, has arranged for the preliminary studies into the life-history of this moth under conditions that pertain to the Okanagan Valley. A commencement of this study will be begun during the coming season (1916) with the main object in view to advise the fruit-growers more intelligently on local methods of control.

CODLING-MOTH CONTROL.

For the purpose of placing before the fruit-growers of British Columbia, more particularly those residing in the Okanagan, a few notes on the control of the codling-moth, in anticipation of this insect assuming importance as a pest in the Province, it has been thought advisable to mention a few important considerations bearing on its life-history and methods of control.

We have not had any opportunity, as yet, to make a searching inquiry into the life-history, the number of broods, or the relation of the movements of the larvæ to the development of the apple under conditions that prevail in the Okanagan Valley. As has already been stated, several small outbreaks have occurred from time to time at one or two points, but the efforts of the Inspectors have been directed mainly towards extermination of the insect rather than to any serious attempt to determine the important points in the life-history of the moth, which would naturally govern the effectual methods of control. It is not supposed that the habits of the moth will vary very much from its habits in the States of Washington and Oregon, in districts of similar climatic influences; consequently, until we have experimental

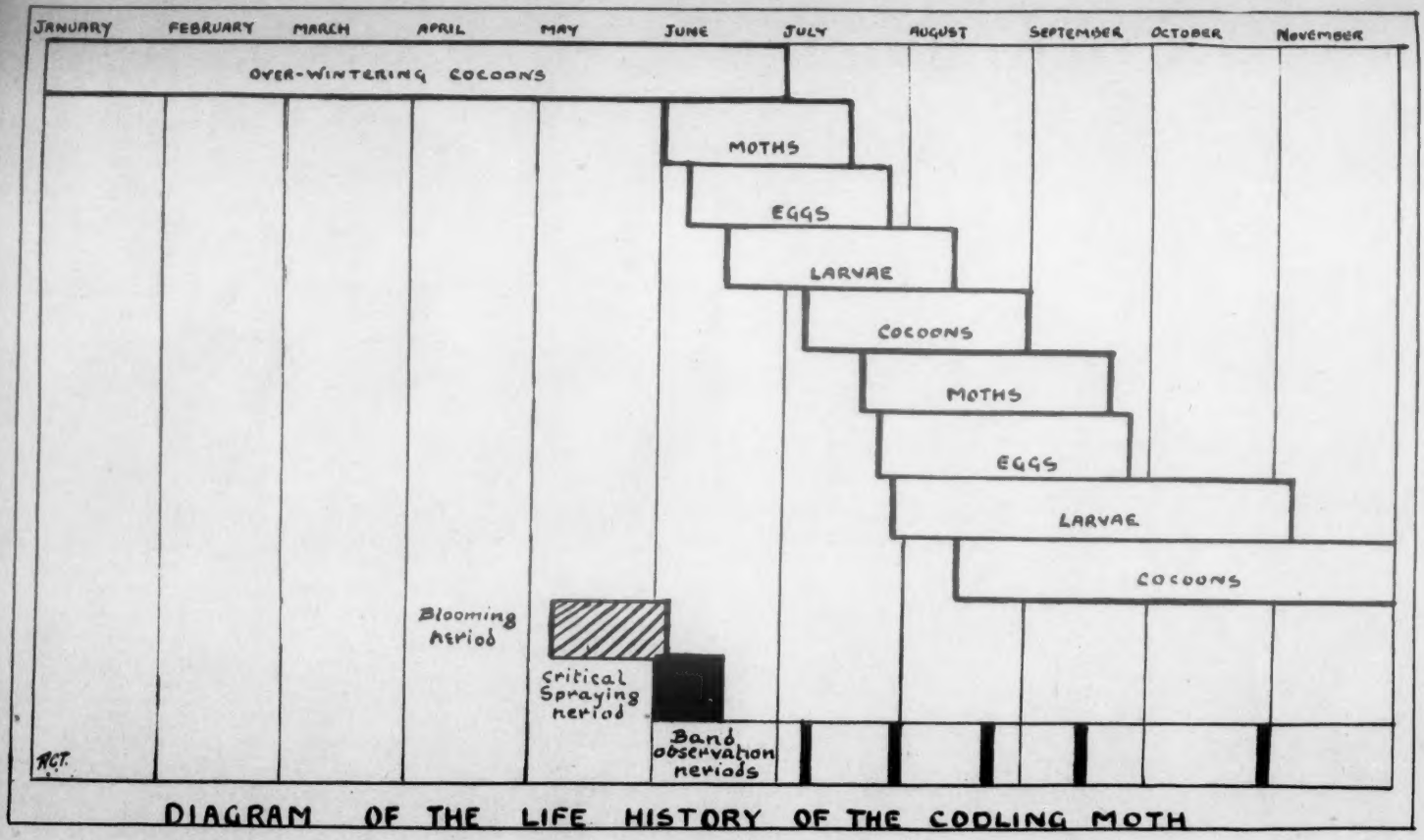


DIAGRAM OF THE LIFE HISTORY OF THE CODLING MOTH

evidence of our own to bear out or to modify the experience of others, we may accept evidence from the South to approximate our conditions.

With the understanding, therefore, that we do not as yet know with certainty the details of the life-history of this insect under Okanagan conditions, the following notes are given:—

The Life-history in General.—The adult, as the name implies, is a moth, and three distinct and different stages are undergone before the adult moth is formed—namely, the egg, the larva, and the pupa. It passes the winter as a "worm" or larva inside a silken cocoon in cracks and crevices of the bark, in shelters under leaves or stones on the ground, and in varied locations in fruit-sheds and store-rooms. In the spring this "worm" forms a chrysalis or pupa inside the silken cocoon, from which the adult moth will eventually emerge. The emergence of the moth occurs during the latter part of May, during June and part of July also. After emergence the adult females prepare to deposit eggs, laying them in due course on the leaves and on the young developing fruits. The eggs eventually hatch to very small larvæ, which penetrate to the core of an apple by way of the calyx. Later, when full-grown, these larvæ leave the apple, as a rule, through the side of the fruit, and form cocoons in places as mentioned above. In northerly latitudes these cocoons are the ones that pass the winter, giving rise to the moths in the spring; but, unfortunately, in the Okanagan there is little doubt that the number of "heat units" that prevail will be sufficient to force development to such an extent that the first eggs, larvæ, and pupæ of the spring will undergo their transformations in shorter time, so that the moths will develop from these early stages, during part of July, in August, and in September. These second-generation moths lay eggs which develop to larvæ, causing a common form of injury known as "side worm-injury," which means the penetration of the fruit by these young larvæ through the side. These worms attain their full growth before winter in the apples, and pass the dormant season in the usual manner as larvæ in cocoons. In southerly and warmer climates the number of "heat units" are sufficient to force a very rapid development, with a result that we find sometimes three and at times four generations occurring during the course of the year.

In the entire Okanagan Valley there is little doubt that the climatic conditions will favour two complete broods, and there is a possibility that in the southern sections of the valley a third or partial third brood will be found. Future investigation will determine this point, which, as may readily be supposed, is of great importance to the fruit-grower, in that it governs the requisite number of sprays. The chart facing page 70 is offered as suggestive of what is implied in the foregoing paragraphs. No excuse is made for inaccuracies which may become apparent when the investigation is pursued, hence the drawing must be taken as an approximate diagram of the life-history of the moth, showing in addition the approximate spray dates and the examination periods of the "bands."

The Control of the Codling-moth by Spraying.—The most effectual method of combating the codling-moth is by applying a poisonous liquid to apple-trees in the spring and during summer.

The Machine used for applying this spray should be a high-power gasolene outfit capable of generating over 200 lb. pressure. The hose should be guaranteed to stand at least 300 lb. pressure. Hand-power pumps are effective if time and care is taken in directing the spray. A hand-syringe would also be of use if the application be made correctly. However, the time required and the relative effectiveness of the spray varies in due proportion to the type of machine used. A gasolene-power outfit, for instance, might be expected to handle 20 acres of large (20-year) trees or 40 acres of small (8-10 year) trees at the critical period in the spring. A hand-power might be expected to handle, respectively, from 5 to 10 acres. A hand-syringe or knapsack pump might spray from six to twelve small trees. The last two machines are, of course, not recommended in practice.

The Object of the Spray is to fill the calyx-cup of the apple with particles of insoluble poison, so that the young worm which usually enters through the calyx will be killed by arsenical poisoning. Pressure and care in directing the spray are requisite for effectiveness, so that particles of arsenic are even forced into the cup between the stamens surrounding the calyx.

The Time to Spray is immediately after the blossoms have fallen, after the fertilization of the flower has taken place. The calyx-cup will be found to be most receptive in shape and condition at this time. It is doubtful whether more than ten days will be allowed the orchardist to finish this spraying, so rapidly does the growth of the young apple proceed in the spring. If the calyx-lobes are closed the object and effectiveness of the spray is offset in due proportion to the degree of development.

How many Times to Spray depends on future investigation under local conditions. However, for the present, a single *thorough* spray applied after the blossoms fall ought to suffice for the season. A second poison spray, applied ten days from the first spraying, is advisable in heavily infested localities. A third and even a fourth spraying is often applied in those sections where the generations of the moth are more frequent.

The Spray Material advised for use is arsenate of lead mixed at the rate of 2 lb. to 40 gallons of water, Bordeaux mixture, or diluted lime-sulphur solution.

The Type of Spray-nozzle required is one capable of throwing a coarse driving stream set at an angle of 45 degrees to the spray-rod.

The Amount of Material required per Tree varies considerably according to the type of the tree and the amount of bloom the tree is showing at the time. Experience will offer the most reliable guide, but for the sake of assisting those with no experience the following formula is suggested:—

For a heavy-blooming tree multiply the age of the tree by ¾, or with a light amount of bloom multiply the age by ½, and the result in each case will give the approximate amount of the diluted mixture required for spraying that individual tree. For instance, if we had five twelve-year-old apple-trees in heavy bloom, to estimate the amount of liquid required, 12 x ¾ x 5 = 45 gallons. This amount of diluted spray would require 2.1 lb. of arsenate of lead; consequently in this way a fruit-grower will, with little difficulty, be able to estimate the amount of material required to be on hand.

Other Methods of Control consist in applying bands around the trees, removal and destruction of wormy apples at all times, and the treatment of moths in store-rooms. The virtues of the last-named methods require no explanation; the first method, however, might be mentioned further.

Banding consists in tying a piece of cloth or a strip of burlap about 8 inches wide around a tree about 18 inches from the ground. The object of this can be readily surmised from a study of the life-history, previously mentioned. The larvæ after completing their growth prepare for pupation, in the summer as well as in the autumn, and in doing so seek the most convenient and suitable place ready at hand. A cloth band on the trunk of the tree is evidently preferable to a flake of bark or a crevice, hence they have no hesitation in forming their cocoons under this band, which becomes a trap. The band may be placed early in July and may be left on until the end of November. The whole effectiveness of this plan, however, depends on the occasional examination of these bands and the destruction of the cocoons found under them; otherwise, if left untouched, the bands become breeding centres most suitable to the propagation of the moth. This point, therefore, should be carefully watched and the bands examined every ten days to two weeks. The most convenient method of setting the bands is in the use of long finishing-nails driven through one end of the "band" half-way into the tree. The band then can be loosely passed round the tree and drawn over the nails and fixed.

Showing calyces of apple ready for first spraying against the codling-moth. A trifle early on left; a trifle late on right; about right in the centre. (After Ball, Utah.)

"Too late to spray." (After Ball, Utah.)

A band in place on trunk of tree. (After Ball, Utah.)

The control of the codling-moth by spraying and banding.

THE SAN JOSE SCALE (*Aspidiotus perniciosus* Comst.).

The San Jose scale is universally regarded as the most serious of the insects affecting fruit-trees and ornamentals in North America. In British Columbia we have been fortunately very successful in thus far maintaining a practical degree of immunity from this pest. Conditions are such that to-day (January, 1916) we are still able to claim that the insect is not a general orchard pest. We are not able to claim, with the same assurance as we used to in the years gone by, that the pest is not known to exist, because unfortunately it has made its appearance at least at one point in the Province.

It would be interesting to review briefly the history of this insect in the Province; points at which its presence is recorded, and methods of its introduction.

In the first place, Fletcher states in his annual report as Dominion Entomologist for 1894 that "on two or three occasions it (the San Jose scale) has been reported to me as occurring in British Columbia; but I had at first the impression that the insect referred to was the scurfy bark-louse (*Chionaspis furfurus* Fitch.) or something else. During the past summer, however, undoubted specimens of *Aspidiotus perniciosus* on apple have been received from British Columbia and have been identified by Mr. L. O. Howard."

This, so far as can be gathered, is the first recorded instance of the presence of this scale in British Columbia. That it was a severe infestation may be gauged by the fact that the "apple-boughs were entirely encrusted with the scales." There was no evidence in Dr. Fletcher's report for 1894 to show where the outbreak was located or how the scale had entered the Province. However, in his report for 1895, he reports a visit he made to British Columbia to investigate the existence of the San Jose scale in the Province, as "undoubted specimens had been received at Ottawa for identification," with the statement that "they had been collected in the Okanagan Valley." The locality in which the scale had been discovered was Kelowna, because in the Report of the Department of Agriculture for the Province of British Columbia for that year it is stated that on the trip to British Columbia by Mr. James Fletcher, 1895, Kelowna was visited on July 25th, when "special examination was made for traces of the San Jose scale." Fletcher was unable to find any sign of the San Jose scale in any of the orchard land existing at that time (1895) around Kelowna. He reported his observations in person to the fruit-growers at their annual meeting of that year held at Agassiz, B.C. In Bulletin No. 3, Department of Agriculture, British Columbia, in the Proceedings of the Second Annual Farmers' Convention on August 1st and 2nd, 1895, Dr. Fletcher's speech is quoted as follows: "Some time ago authentic specimens of the San Jose scale were sent to me from British Columbia . . . with the statement that the insect was doing harm to apple-trees. I am pleased to be able to tell you . . . that although the insect certainly did occur . . . for the identification was confirmed by Mr. L. O. Howard . . . it is safe to say it does not now exist in any of the orchards around this original locality."

It is interesting to note that the scale at this time (1895) was only just beginning to make its appearance in Ontario. In fact, with the exception of a locality in Kent County, Ontario,* in which the San Jose scale was observed in 1893, Kelowna, B.C., has the doubtful honour of being the first infested locality in Canada. Prompt remedial measures were advised by Dr. Fletcher on the first intimation of the outbreak at Kelowna, with the result, as above stated, that in 1895 no sign of the scale existed either at Kelowna or at any other point in the Province.

The next year, however, 1896, brought forth another report of the existence of this scale in British Columbia, but on this occasion it was found near Victoria, on Vancouver Island.†

Mr. R. M. Palmer, at the time Provincial Inspector of Fruit Pests, deserves the credit for discovering the scale in this new locality. Specimens of infested wood

* Evidence, Dr. J. Fletcher, before Select Standing Committee, 1906-1907.
† Report of Dominion Entomologist, 1896, page 254.

were sent to Ottawa, and Dr. Fletcher and, through him, Dr. L. O. Howard confirmed Mr. Palmer's supposition as to the identity. Mr. Palmer reports that certain trees in two orchards were infested, but that these trees were cut down and destroyed.

There seems little doubt that both the Kelowna outbreak in 1894 and the Victoria outbreak in 1896 were true and authentic instances of the presence of the scale in the Province. Inasmuch as no further record has been made of the scale from these localities up to the present time indicates that prompt and successful initial steps were taken towards eradication.

In 1897 two reports of the scale were made as occurring on Saltspring Island and at Nanaimo, B.C., but these reports were contradicted later, with the statement that "no San Jose scale now occurs in the Province" (R. M. Palmer, November 21st, 1900).

The rapid increase of the scale in Ontario and the danger of introducing it into new localities through the medium of nursery stock induced the Dominion Government to pass the "San Jose Scale Act" on March 13th, 1898. This Act was, in 1900, amended to allow for the process of fumigation at ports of entry for incoming nursery stock into the various Provinces. Vancouver was selected as the port of entry for British Columbia, and all incoming nursery stock was dealt with there in accordance with the provisions of the Act.

In 1905, however, two outbreaks of the San Jose scale occurred in the Province, according to Dr. Fletcher's report for 1905. One of these appeared at Kaslo, B.C., and was reported by Mr. J. W. Cockle. The other, as reported by Dr. Fletcher in 1908, occurred at Spences Bridge, B.C. In both these cases it was evident that infested trees were imported into the Province previous to 1900 and the consequent enforcing of the fumigation regulations. The Kaslo infestation was soon eradicated, but the Spences Bridge outbreak has persisted until the present day (November, 1915).

In connection with this latter outbreak, which apparently had its origin from infested young apple-trees imported from Ontario, a "whole orchard was cut down" in 1908.*

In 1912 I had the opportunity of examining some twigs of apple from Spences Bridge which were infested with the scale. Mr. Thomas Cunningham, Provincial Inspector of Fruit Pests, dealt with the matter as he deemed advisable, which resulted in a certain number of trees being cut down and full instructions regarding spraying being given for the remainder. In the summer of 1913 Mr. Cunningham authorized Mr. F. H. Getchell, Field Inspector, to visit Spences Bridge and report on the condition of the scale. Mr. Getchell was able to find one wild cherry-tree that was infested growing on some waste ground near the Canadian Pacific Railway track. This tree was promptly cut down. In October, 1915, I was surprised to receive a consignment of apples from Mr. M. H. Ruhmann, Assistant to the Provincial Plant Pathologist, Vernon, B.C., which were badly infested with the San Jose scale. Inquiry into the origin of these fruits resulted in the information that they were grown at Spences Bridge and that he had received them, in turn, from Mr. L. L. Palmer, Assistant Inspector of Fruit Pests. Mr. W. H. Lyne, Assistant to Mr. Cunningham, at the latter's request, immediately visited the infested locality and carried on a campaign of extermination; time will show with what success.

In October, 1915, again I received information that some San Jose scale was present at Chase, B.C., in small quantity. This report has not as yet been substantiated, but it is thought probable that the scale is *Aspidiotus ostreæformis*. A similar report occurring at about the same time from Kelowna proved to be this latter species, which, while universally distributed over the Province, is not considered of prime importance as an orchard pest.

In the Annual Report of the Entomological Society of Ontario, 1912, I took the opportunity of drawing attention to the fact that the San Jose scale is gradually

* Report of Dominion Entomologist, 1907-1908.

advancing up the Okanagan Valley from the State of Washington, and that it was only a question of time when the scale would occur in British Columbia as a general orchard pest. In the *Canadian Entomologist*, XLVII., No. 4, April, 1915, it is stated that the scale had reached a point in 1912 at the junction of the Columbia and Okanagan Rivers, a point approximately sixty miles south of the British Columbia boundary-line.

The history of this scale, therefore, in British Columbia has been very interesting, and we are watching with a great deal of concern its future developments. It is to be hoped that the fruit-growers of the Province properly realize the importance of this insect, and that these statements above will assist them in gauging the present conditions as they exist.

A thorough drenching of the trees infested by the scale with commercial concentrated lime-sulphur solution diluted 1-8, applied in spring as the buds break, will effect control.

Showing typical injury to apples by the rosy aphis. Frequently at the season of the year when the above is noted no aphides are seen in the cluster of leaves or apples. This is accounted for by the fact that the aphides have migrated from the apple-trees to some other food-plant. The injury, as seen, is a result of an early spring attack. (Photo by R. C. T.)

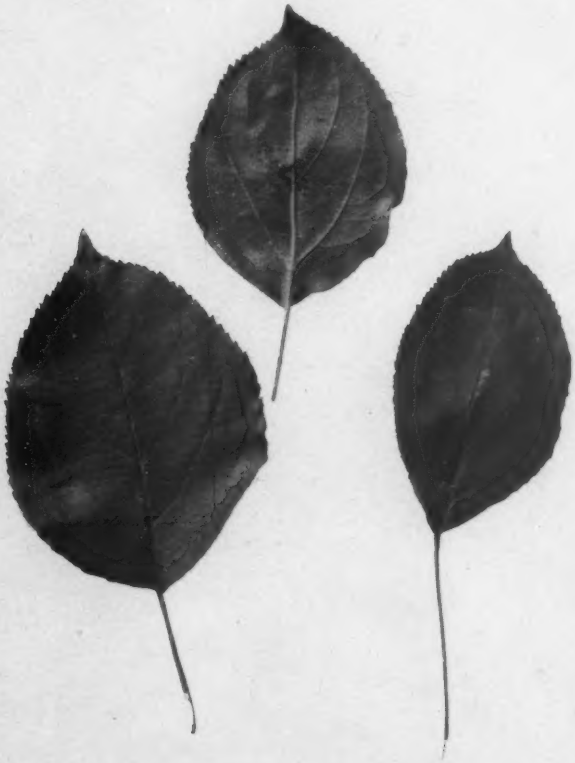
THE WOOLLY APHIS (*Eriosoma lanigera* Hausm.).

In the year 1892 this well-known insect was reported to occur at Aldergrove, Chilliwack, Maple Ridge, Saltspring Island, and Comox. In 1893, according to the Provincial Department of Agriculture reports, it was reported from Langley, Cheam, Hammond, Port Moody, Victoria, and Comox, and to have increased noticeably in area over previous records of infestation. Nevertheless, we are informed that the "woolly aphis used sometimes to be noticed in 1893,"* which would indicate that in that year this insect was not considered common in the Lower Fraser Valley. Its occurrence, as may be seen from the foregoing localities, was confined to the Lower Mainland and to Vancouver Island, particularly, it would seem, to the latter locality, according to Mr. E. Hutcherson, Provincial Inspector of Fruit Pests, in the Second Report of the Department of Agriculture, 1892, who claims that this aphis

* Proceedings of the British Columbia Entomological Society, No. 4, 1914, page 69.

is "present to an extraordinary degree in every orchard or nursery visited in the Victoria District."

In the year 1894* this aphis continued to increase and to spread its area of infestation on the Lower Mainland. At this time it was not known to occur in the Okanagan Valley, except at Okanagan Mission, where, it was supposed, a few specimens existed in 1893. Fruit-growers in the valley at the time were advised to "exclude this pest from their midst" and to use care in the selection of nursery stock for fear of its introduction. For many years the Okanagan Valley remained free from this pest, but there is no evidence to show any spread from original points of introduction. In 1912 Mr. W. H. Brittain synopsized the situation in the Okanagan Valley as follows: "Fairly common everywhere throughout the season . . . no root forms seen . . . not a serious pest in well-cared-for orchards."† In passing, it is interesting to note in the same report that Mr. M. S. Middleton, Assistant Provincial Horticulturist, stationed at Nelson, B.C., makes the statement that the aphis has not made its appearance in the Kootenay Valleys.



Showing the work of the young larva of the bud-moth on apple-leaves in late summer and autumn. The upper leaf shows the under-side with the larva feeding on the tissues. The other two leaves show the work of the larva as viewed from the upper surface. As the leaves commence to fall the young larva migrates to some sheltered crevice on the twigs or trunk of the tree, and thus over-winters. (Photo by R. C. T.)

* Fourth Report of Department of Agriculture, 1894, "Insect Pests."
† Proceedings of the British Columbia Entomological Society, No. 2, 1912.

In July, 1913, Mr. L. L. Palmer refers to the woolly aphis as one of the most serious pests to the orchardist around Vernon, and draws attention to the presence of root-infesting forms in that locality.

In the meanwhile, in the Lower Fraser Valley the woolly aphis has grown to the rank of the most common orchard insect in the valley. It occurs everywhere on root and stem from Vancouver to Agassiz.

In 1914, according to Mr. M. H. Ruhmann, in the Proceedings of the British Columbia Entomological Society, No. 7, 1915, the woolly aphis "was present in all the older orchards throughout the Okanagan Valley, the root form not being so often met with."

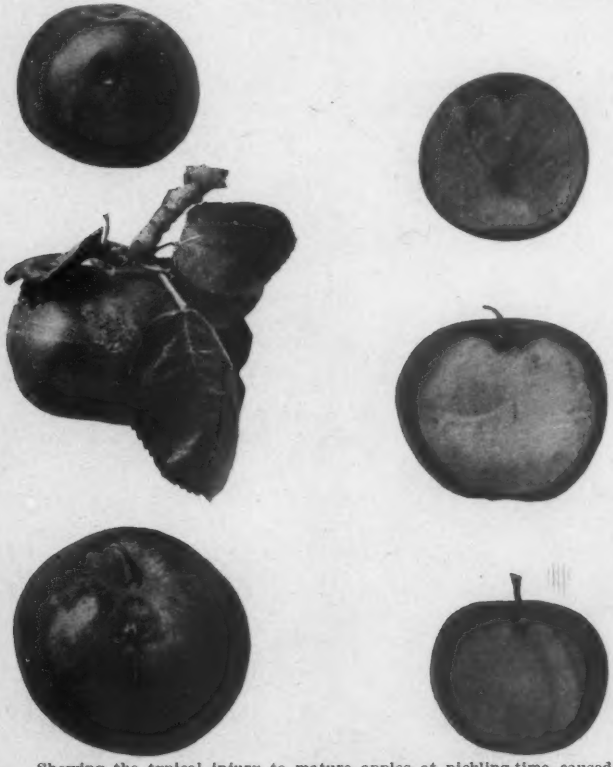
During 1914 I had the opportunity of visiting the Okanagan Valley for the first time after having spent two years in the Coast districts. If there was one thing more than any other that struck me on that visit it was the "comparative" absence of this woolly aphis, and the report from many quarters of its increase in many localities. There seems little doubt that, while the wooly aphis may have been present in the Okanagan Valley since and before 1893, it has not as yet spread over the existing orchard area to the same extent as it has done on the Coast. I am inclined to think that the woolly aphis, like the oyster-shell scale, is an insect particularly adapted to a humid moist climate, where it would be more liable to find conditions suitable to optimum development than in arid sections. However, there is no doubt that climatic conditions in the Okanagan would suit it well enough to enable it to cause a considerable amount of injury; therefore it is advisable that due regard be paid to its spread and reproduction in the Upper Country.

THE BUD-MOTH (*Tmetocera ocellana* Schiff).

The first report of the bud-moth occurring in British Columbia is that recorded in the Fifth Annual Report of the Horticultural and Fruit-growers' Association of British Columbia, 1894. In that year specimens of the bud-moth were reported from the vicinity of Vernon, B.C. This appears to be the first report for the Province appearing in print, but the impression is given both in the 1894 Report as well as in the 1892 Report, that the insect occurred at the time in the Lower Fraser Valley. Dr. J. Fletcher, in his report as Dominion Entomologist, 1895, mentions receiving specimens of the bud-moth from the orchard of Mr. C. F. Pound, St. Elmo, B.C., and remarks that these were the first specimens he had received from British Columbia. Even in 1903 this insect did not occur commonly in the Province. Since 1911 it has been found present in every orchard visited in the Lower Fraser Valley. Adults have been bred and compared with Eastern Canadian specimens and their identity is certified. It is well to say this, because we are yet a little doubtful as to the identity of some other "bud-worms" very similar in nature to the bud-moth. In this year (1915), however, we may state that the bud-moth (*T. ocellana*) occurs commonly both on Vancouver Island and on the Lower Mainland. In the Okanagan it remains somewhat scarce. Mr. Brittain reports it as working in several orchards in the Kelowna District in the summer of 1913, but "not in sufficient numbers to do a great deal of harm." In August, 1914, I visited the Okanagan and made a special endeavour to determine the distribution of the bud-moth. I realized that doubt had been expressed as to the probable species involved in injury of a similar nature, hence I was careful in determination. I am of the opinion that the bud-moth (*T. ocellana*) occurs at Vernon, Kelowna, and at Penticton. Kelowna was the only point where bud-moth injury attracted attention; at other points careful examinations had to be made because the insects were not common. It is to be hoped that the next few years will throw more light on the identity of the species of "bud-worms" involved, because at present there is much confusion. At any rate, the important point is apparent that every year adds a little more area to the extent of infestation in the Okanagan; consequently growers are advised to watch the advance of this insect for fear it becomes as well established as it is at present in the Lower Fraser Valley.

TWO PESTS NEW TO BRITISH COLUMBIA.

I regret very much to have to record two new pests which have made their appearance in British Columbia during the past year (1915), and both from Vancouver Island. The first and the most important, both in point of numbers and injuriousness, is the pear-thrips (*Tæniothrips pyri* Daniels), and the second is the black currant bud-mite (*Eriophyes ribis* Nalepa). The appearance of these two pests is both interesting and extraordinary. Neither has been recorded for Canada previous to this occasion, and the latter in particular has not, to my knowledge, as yet been reported as occurring in open field plantations in North America. The



Showing the typical injury to mature apples at pickling-time caused by the young larvæ of the bud-moth. Apples are frequently disfigured and rendered of lower value by injury of this nature. The injury is shown in sectional view and the depth to which the larvæ work. This form of injury assists decay in storage. (Photo by R. C. T.)

former, however, is known to occur at several but widely separated fruit areas in the United States. The history of their occurrence in British Columbia is somewhat as follows:—

THE PEAR-THRIPS (*Tæniothrips pyri* Daniels).

During April, 1915, Mr. T. A. Brydon, fruit-grower, Royal Oak, reported to Mr. Thomas Cunningham, Inspector of Fruit Pests, that the first-spring spray that he had used on the latter's suggestion had injured his trees, so much so that the blossom-clusters were turning brown, and it was evident that little fruit was setting. Mr. Brydon, believing this apparent injury due to the spray applied, did not spray

Showing an advanced condition of attack by the larvæ of the bud-moth in the early spring months. Note how the buds are destroyed and development checked. An early spring spray containing arsenate of lead will reduce injury. (Photo by R. C. T.)

the remainder of his orchard which still required applications. He was astonished, a few days later, to note that these unsprayed trees also showed signs of injury similar to the sprayed trees. He accordingly reversed his opinion on the effect of the spray and reported the state of affairs both to Mr. R. M. Winslow, Provincial Horticulturist, and to Mr. Cunningham. Mr. Winslow immediately visited Mr. Brydon and noted the presence of thrips in the blossoms of peach, plum, pear, prune, apple, and cherry. Mr. E. W. White, on Mr. Cunningham's instruction, visited the orchard about the same time and noted the same conditions.

Mr. Winslow immediately took steps to have the insects identified, attributing the injury to them. Specimens were sent to Mr. S. W. Foster, San Francisco, and to Berkeley University, California. Through the medium of Mr. White I received specimens also, which I tentatively identified as the pear-thrips. Specimens were in due course forwarded to Dr. C. Gordon Hewitt, Dominion Entomologist, Ottawa, who, to satisfy our determination, forwarded some to Washington, D.C., for substantiation. In the course of a few days reports from all sources were received and the identification in each case was identical. The species involved was *Tæniothrips pyri* Daniels. Immediate steps were then taken to estimate the extent of injury and the area involved. As a result, it was found that an area approximating twelve square miles was involved in the outbreak, with centres of infestation at Royal Oak, Keatings, and Gordon Head.

On May 7th and 8th, at the request of Mr. Winslow, I made a survey of the district and arranged a series of meetings with the fruit-growers at each of the three places mentioned. Simultaneously, through the energy of Mr. Winslow and

Mr. Cunningham, remedial measures in the form of soap-emulsion sprays were applied wherever deemed advisable, but it has to be acknowledged that a part of the spray, at any rate, was applied too late for best results. Most of the injury had been caused, and the thrips were naturally leaving the trees during the first days of May. The fruit-growers were therefore advised fully as to their danger and the serious nature of the insect, and strongly urged to take efficient steps to safeguard their interests for the coming spring of 1916.

The life-history of the thrips, according to Californian reports, is such that the nymphs, after leaving the trees in May, penetrate into the soil and do not appear until the blossoming period of the following year. The safest spray to apply under our present knowledge of conditions around Victoria is a mixture of whale-oil soap and nicotine sulphate.

The following formula is recommended until our knowledge is further supported by experimental data: Nicotine sulphate (B.L. 40), ¾ pint; water, 100 gallons; whale-oil soap, 5 lb. A pressure of at least 200 lb. is advisable, and two, and if possible three, early-spring applications are required.

There is no explanation of an exact nature which can be offered explaining the outbreak of these thrips around Victoria.

Mr. Brydon, who is responsible in the first place for having drawn attention to the insects, believes them to have been present in his orchard at least six or seven years previous. The blighted condition of blossoms in the spring had been noted in his orchard for that length of time, but the cause was usually attributed to some slight frost at a critical period. There seems little doubt that the thrip has been present in the district for several years, and that with the unusually mild winters and early springs that have been experienced in that locality during the past two years, conditions were suitable for optimum development. It is possible that the past winter (1915-16), which has been somewhat unusually cold, may have the desired effect of checking the outbreak, but it is well to be on the safe side and prepare for a continuance of the outbreak. I am pleased to inform you that Dr. C. Gordon Hewitt is making arrangements for a complete study of this insect in respect to its biology and control, and the initial steps in this connection will be begun this spring (1916).

The Black Currant Bud-mite (*Eriophyes ribis Nalepa*).

This mite has frequently been taken at inspection stations in Canada, arriving in consignments of black currants from Europe. It is only this past spring, however, that we are forced to record its presence in the open field plantations in British Columbia.

On the evening of April 7th, 1915, I was accorded the pleasure of delivering an address before the Natural History Society of Duncan, V.I. In the discussion that followed, Mr. R. Glendenning, Secretary of the Society, asked whether or not the black currant bud-mite was known to occur in Canada. I was forced to admit that the mite was not known to infest our field plantations in Canada. He thereupon stated that some injury very similar to that of the bud-mite, as he knew it in England, was present on some currant-bushes he had in his garden, which he had, in the first place, bought from a local nursery, and which had originated in England.

Mr. Glendenning accordingly, the following morning, on my request, produced some supposedly infested twigs. There was no doubt that the buds were infested by *Eriophyes ribis*. My determination was later supported by Dr. C. Gordon Hewitt, Dominion Entomologist, who was satisfied that the species was identical with the bud or gall mite of Europe.

On inquiry it was found that this mite must have been working in the field plantations to some extent for the past five or six years. The bushes found infested at Duncan had been sold by the "Vancouver Island Nursery Company," Somenos, V.I. As far as could be learned, approximately 5,000 currant-bushes had been disposed of by this firm between the years of 1910-13, and all these bushes apparently

were sold to local growers on Vancouver Island. For the past two years the nursery has ceased to exist, and the owner is at present on military service in Europe. The books of the company, therefore, are closed and we are not able to obtain the names of purchasers.

The importance of this mite is well understood by those who have experienced its ravages in England; consequently prompt and efficient steps are urgently required to stamp it out. Growers of currants are advised to report its presence to the Government if their suspicions are aroused. Affected bushes are most easily observed in the early spring, when the buds of such bushes swell abnormally, eventually dropping off or setting no fruit. The only remedy advised in consideration of the present status of the currant industry of the Island is to destroy affected bushes by burning.

SUPERHEATING AS A CONTROL METHOD FOR INSECTS WHICH INFEST STORED PRODUCTS.

BY ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

There are several important insects which collectively are responsible every year for serious losses to flour, stored grain, etc., in various parts of Canada, such losses amounting to many thousands of dollars. The Mediterranean flour-moth (*Ephestia kuehniella*) is largely a flour insect, but it also works in other manufactured foods. The Indian-meal moth (*Plodia interpunctella*) has a wide range of food, attacking, freely, grain and other seeds, meal, dried fruits, nuts, etc. The meal snout-moth (*Pyralis farinalis*) is some years found causing considerable injury to stored grain, etc. The Angoumois grain-moth (*Sitotroga cerealella*) is occasionally found in shipments of corn-seed imported from foreign countries. The power of granary-weevils and similar small beetles to destroy grain and other stored products when held for any length of time in stores or warehouses is enormous. The weevils which cause the greatest damage are the grain-weevil (*Calandra granaria*) and the rice-weevil (*Calandra oryzæ*). In addition to these weevils there are several small reddish-brown beetles which commonly infest stored grain and mill products. Breakfast foods, flour, meal, dried fruits, nuts, etc., are all attacked.

Recently the Entomological Branch has had opportunities of experimenting with high temperatures for the control of insects infesting mills and warehouses, and the results obtained have been highly satisfactory. In the superheating method of control it is necessary to install a system of heating which will give and maintain a temperature of from 120° to 125° Fahr. for about six hours. In stores or warehouses the established heating system will require to be augmented by coal, wood, or gas stoves, particularly in autumn and during the colder months. A number of flour-mills in the United States which are heated by steam have installed additional radiation at a cost not exceeding the expense of one fumigation with hydrocyanic-acid gas, which has been used to such an extent in the past for destroying insects infesting flour and other stored products. The additional system of radiation is permanent, and one application of the superheating method each year has been found to be sufficient to control such insects. In Canada, also, the superheating method has been adopted in flour-mills to control the Mediterranean flour-moth. In the Montreal district, for instance, the flour-mills are regularly, each summer, subjected to high temperatures to destroy this insect. In instances where mills and warehouses have been infested with such small beetles as the confused flour-beetle (*Tribolium confusum*), and fumigated with hydrocyanic-acid gas, it has been found that the gas did not penetrate sufficiently deep into all cracks, etc., to kill the insect in every stage. The superheating method, however, reaches the places inaccessible to gas and destroys any insects which may be present.

The following brief statement will indicate the value of high temperatures as a control measure for such insects as I have mentioned:—

In October, 1913, Mr. W. A. Ross, Field Officer of the Entomological Branch, conducted an experiment in a large feed-store at Dundas, Ont., which was badly infested with the Mediterranean flour-moth. Myriads of the moths were present and the meal and flour in the sacks were literally alive with caterpillars. The heating system consisted of five steam-pipes, which extended half-way around the walls, and four box stoves. Practically half of the second floor was occupied by a suite of offices heated by steam-radiators. In the unheated portion of this flat one box and two steam-gas stoves had been installed, and on the top flat four gas-stoves.

At 6 p.m. the steam was turned on and the stoves were lighted. At 1 a.m. the moths in the bins on the top flat commenced to succumb to the heat (114° Fahr.). At 10.30 p.m. the following day no living insects could be found on the second and third flats. The temperature on the third floor had reached 120° Fahr., and on the second floor 108° Fahr. in one place and 120° Fahr. in another. The thermometers available and used on these floors did not register higher than 120° Fahr. On the first floor five extra stoves were installed owing to the fact that the temperature in the immediate neighbourhood of the floor was not sufficiently high to prove fatal. The heating on this floor was begun at 9 a.m. and discontinued at 6 p.m. Better thermometers were obtained and these registered as high as 147.2°, 120°, and 150.8° Fahr. The one which registered 120° Fahr. was lying on the floor near a door. Two weeks later Mr. Ross again visited the store and no sign of the insect could be seen, nor had any been noticed by the owner of the warehouse or his men since the building was superheated.

One other experiment to which I will refer took place in a large seed-store at Victoria, B.C. The insects present in this instance were the two granary-weevils—namely, the grain-weevil (*Calandra granaria*) and the rice-weevil (*Calandra oryzæ*). Both weevils had been found working freely in stored grain. Towards the end of April, 1914, we recommended to the proprietors of this store that they adopt superheating to destroy the insects. This they did, the temperature being raised to between 115° and 125° Fahr. and maintained for about eight hours, with the desired effect. Steel oil-barrels were used as stoves to raise the temperature. Holes were punched in these, near the bottom, so as to provide a draught, and coke was used as a fuel. Previous to the superheating, fumigation with bisulphide of carbon had been tested, the amount of bisulphide used being approximately 3½ lb. to every 1,000 cubic feet of space. The building consisted of four floors, of a size 30 x 110 feet, three being 10 feet high and one 14 feet high. The liquid was poured into tin vessels which were distributed throughout the building. This fumigation killed large numbers of the adults, but did not have any effect upon the eggs. Consequently, later, the superheating method was adopted with entire satisfaction.

As mentioned above, the heat from a high temperature of 125° Fahr. maintained for several hours penetrates into all cracks, etc., killing all stages of the insects present.

CONTROL OF CABBAGE-APHIS BY PARASITES IN WESTERN CANADA.

By E. H. Strickland, Lethbridge, Alberta, Field Officer, Entomological Branch, Dominion Department of Agriculture.

The cabbage-aphis (*Aphis brassicæ* Linn.), though a native of Europe, is now widely distributed in America, where it was first recorded in 1791. In Fletcher's report for 1895 it was stated that a "grey aphis (possibly *A. brassicæ*)" had been very destructive on Vancouver Island, and that the worst year on record was 1876. There can be little doubt but that this note referred to *A. brassicæ*, which has been recorded frequently from this locality since that date. It has therefore been present in British Columbia for at least forty years.

Very briefly the life-history of this aphis is as follows: The small shining black eggs are laid in the fall on cabbage stumps and leaves. They may be found also on

infested turnip, mustard, or rape leaves. They hatch in the spring into wingless female aphides, known as "stem mothers." These mature in about two weeks and begin giving birth to another generation of females, which in their turn mature rapidly and are soon actively producing a third generation. This rapid production of new generations of wingless females continues throughout the summer. Occasionally winged specimens appear, and fly to new plants, thus spreading the infestation. Males are not produced until the fall. These mate with the females, and as a result the latter produce eggs instead of living young. It is these eggs which pass the winter; no other stage of *A. brassicæ* is able to do so.

Egg of *Aphis brassicæ* as laid on cabbage.

The alarming rate at which these aphides increase might make one wonder how it is that all cabbages, wherever this pest is found, are not invariably and quickly destroyed. One, and perhaps the chief, reason is that the aphis has several natural enemies which are continually reducing their numbers.

These enemies are divided into two classes—viz., predators and parasites. Among the predators are found both the larvæ and adults of ladybirds (*Coccinellidæ*), the larvæ of hover-flies (*Syrphidæ*), and the larvæ of lace-wings (*Chrysopidæ*). These we can probably aid or harm but little. Several parasites have been bred from *Aphis brassicæ* in different parts of the continent, but from material studied in South Alberta during 1914 and 1915 one species only has been bred. This is a small Hymenopteron, named *Diæretus rapæ* Curt. Since this species parasitizes a large percentage of the aphides, and it is present in the fields and gardens from the time when the stem mothers hatch, it is very valuable for preventing outbreaks of cabbage-aphis.

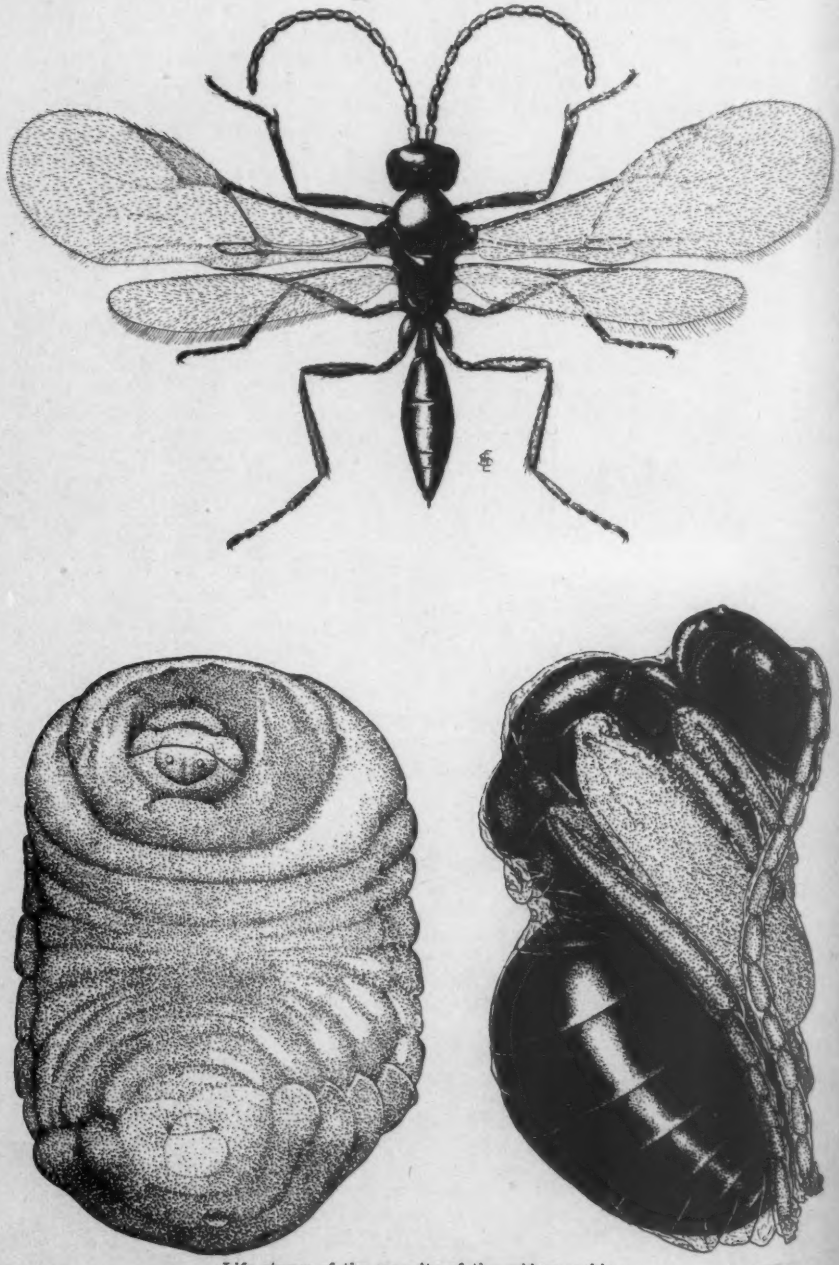
The life-history of this parasite is similar to that of most of the aphis parasites. The adult buries its egg inside an aphis with the aid of its ovipositor. From this egg hatches an orange-coloured larva, which develops rapidly at the expense of its host. By the time it is full-grown the body of the aphis has become much swollen, and is almost spherical, while its "skin" has changed from a dull-grey to a straw-yellow colour, and is of a parchment-like consistency. The parasitic larva by this time completely fills the dead aphis, which is firmly cemented to the cabbage-leaf upon which it was feeding. Within it the parasite pupates, and later the adult emerges through a circular hole. How many generations of this parasite there are in a year we do not know, but there must be several. The most important point for us to consider is the manner in which the winter is passed.

Late in the fall many of the aphides contain fully developed parasitic larvæ, pupæ, or occasionally adults which have not emerged. These aphides, with their contained parasites, are so firmly attached to the cabbage leaves and stumps that they remain on them throughout the winter. The first severe frosts kill off all normal aphides, leaving only the parasitized specimens and the small black eggs produced by the fertilized female aphides of the last generation.

If we examine some of the parasitized aphides in the early spring we find that in most cases where they contain a full-grown *Diæretus* larva this larva is alive and healthy. We find also that the pupæ of the species have passed the winter successfully, but that the few adults which we dissect out are in every case dead.

During the first week in April adults began to hatch from material collected at Lethbridge earlier in the spring. From this it is seen that both the aphis and its valuable parasite pass the winter on the cabbage stumps and leaves.

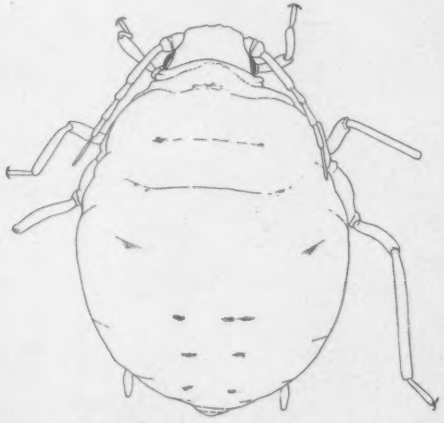
In passing, we might mention that in some of the parasitized aphides we found an unwelcome guest, which was passing the winter in the same stages of develop-



Life stages of the parasite of the cabbage-aphis.

ment as *Diæretus rapæ*. This insect was determined for us by Mr. Girault, of the United States National Museum, as "near *Pachyneuron*." This small green Hymenopteron lays its egg on the ventral side of the orange-coloured *Diæretus* larva. From it hatches a white hyperparasitic grub, which slowly increases in size at the expense of its shrinking host, till we find, instead of a large orange larva with a small white grub on its ventral side, a large white larva with a small, shrunken, orange-coloured skin on *its* ventral side. Still later we find the pupa or adult of the hyperparasite. Since, however, we bred forty-three *Diæretus* adults to every *Pachyneuron*, the flies which we hatched from our parasitized aphides were decidedly beneficial.

The question which now arises is: Can we aid these parasites in any way without at the same time aiding their host, the cabbage-aphis? In dry, cold latitudes we certainly can, but it must be borne in mind that the following suggestion applies only to such places as the Interior of British Columbia and to the Prairie Provinces, where the cold is sufficiently intense to kill off all cabbage-growth with certainty before the spring.



Parasitized larva of *Aphis brassicæ* containing the over-wintering parasite. (In nature it is very much swollen and enlarged.) (Del. E. H. S.)

A control measure advocated in the east and to the south of us is that of collecting and burning all old stumps and other refuse during the fall and winter. This is very beneficial since it destroys numerous aphis-eggs. Where there is much snow or where the winter is not severe, such stumps are not killed by the spring, and even though they are pulled they may have enough vitality to produce sufficient green growth for the young aphides that hatch from the eggs to mature and produce a winged generation.

Under our conditions, however, such growth is impossible, and we can obtain even better results from a modification of this method. The stumps and refuse must be collected during the fall or winter, and placed in a heap on an absolutely bare piece of land, at some little distance from any green growth, especially any such weeds as shepherd's-purse, mustard, or any of the plants belonging to the order Cruciferæ, since *Aphis brassicæ* can breed on almost any of these.

In the spring both the parasite adults and the aphis-eggs hatch. The parasites are strong-winged and can rapidly fly to more favourable locations, but the tender wingless aphides are too far removed from any food to stand a chance of crawling to it before they die of starvation. A few may possibly be blown or carried by birds to some cruciferous plant, but this number must be very small, whereas innumerable parasites are continually escaping.

From a large heap of badly infested stumps on the Experimental Farm at Lethbridge a constant flight of parasites was observed during April in 1915, while numerous minute aphides were seen crawling over the heap of well-frozen and lifeless stumps. Some of the aphides were hatched in captivity and lived for two or three days only. None was seen to attempt to feed upon the over-wintered cabbage-tissues.

The foregoing suggestion must not be considered as an excuse for leaving cabbage-stumps, etc., lying around in the fields during winter. It is just as essential that all refuse be collected and placed on a clean piece of land, which must not be allowed to grow up to weeds during April or early May, as it is to collect such refuse for burning. We would repeat, also, that this is applicable only to those localities in which the winter is always sufficiently severe to ensure that all refuse left over from cabbage or turnip crops is completely killed. In such localities we would recommend that some such arrangement be made so that we do not annually kill off a large percentage of our best friends, and then inadequately replace their rôle in nature with expensive spraying.

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